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C³ Modified TACWAR Model

by John C. Ingram



U.S. Army Electronics Research
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Harry Diamond Laboratories

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20. Abstract (Cont'd)

nuclear and chemical delivery system and warhead inventory effectiveness. The C³/D modified TACWAR model has been run using an unclassified "benchmark" data base. Communications degradation and message processing delay data are provided by the TACNET theater-level C³ model. Parametric studies reveal the effect of C³/D on the results of theater-level engagements.

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1. INTRODUCTION

The TACWAR theater-level combat simulation model was developed by the Institute for Defense Analysis (IDA) for the Department of Defense Studies Analysis and Gaming Agency (DoD-SAGA). Presently, TACWAR is being maintained for SAGA by the Defense Communications Agency Command and Control Technical Center (DCA-CCTC).

Since TACWAR does allow theater-level combat assessments, it is being considered as a prime candidate to provide results to the "net assessment" task of the Army-sponsored Theater Nuclear Forces Survivability (TNF/S) program. A broad-scoped program, TNF/S encompasses a number of major task (and subtask) areas including target acquisition; nuclear-chemical-conventional kill; logistics; combat degradation; unconventional warfare; electronic warfare; and command, control, and communications degradation (C³/D).

Each of these major areas of analysis is controlled by a designated "lead element" who is responsible for coordinating and assessing that portion of the overall program. The author is a member of a team of the Electronics Research and Development Command, Harry Diamond Laboratories (ERADCOM-HDL) that is assisting the Combined Arms Combat Development Activity (CACDA), the designated lead element for C³/D.

A thorough analysis of TACWAR revealed that very little C³ is modeled explicitly. Consequently, it was decided that those areas within TACWAR that are of major interest and importance to TNF/S-C³/D will be modified to include C³/D effects. This report describes those modification efforts, including the rationale for the modifications, the methodology employed, and the explicit FORTRAN code changes that have been implemented. Initial data values and the results of some sample runs also are provided.

2. SUMMARY OF TACWAR

In its broadest categories of simulation, TACWAR can be divided into five major areas of combat or control:¹

- Air combat
- Nuclear combat
- Chemical combat
- Ground (with air-ground interaction) combat
- Theater control

¹Institute for Defense Analysis Tactical Warfare (TACWAR) Model, Defense Communications Agency CCTC Computer System Manual CSM MM 237-77, Parts I, II, III (6 September 1977).

Each of these areas was analyzed to determine if C³/D effects could be readily incorporated into the simulation. The analysis is summarized in the following paragraphs.

2.1 Air Combat Simulation

In TACWAR, aircraft, aircraft shelters, and personnel are stationed at specific airbases. These airbase assets are consolidated within specified geographical "regions" of the theater to establish a "notional" or average airbase. For each of these notional airbases, aircraft are allocated to specific missions, including close air support (CAS), interdiction, and airbase attack. The number of aircraft available for these missions is a function of the operating capability of the actual airbases and will depend on C³/D.

As a first order effect, the dependence of airbase operating capability on C³/D can be accounted for by the degradation function currently available in TACWAR. Other C³/D effects in the air model such as air-to-air coordination and CAS communications are secondary TNF/S considerations. Consequently, no changes in the air combat model are made to include C³/D explicitly.

2.2 Nuclear Combat Model

The nuclear model in TACWAR includes an escalation process, a prioritized weapons assignment list, target acquisition, a prioritized target assignment list, a weapon-to-target selection process, and a target damage evaluation process. Important C³/D effects in this model include (1) delays in nuclear escalation and in target acquisition processing due to degraded C³ and (2) lower effectiveness of nuclear delivery means. Delays in nuclear escalation and in target acquisition can be incorporated into TACWAR by providing an explicit functional dependence of the delay time with degradation of C³ assets within the several areas (echelons) of control such as division, corps-sector, and theater delivery systems. Similarly, nuclear delivery system effectiveness (availability) can be described as a function of C³/D.

2.3 Chemical Combat Model

The chemical model in TACWAR has essentially a one-to-one correspondence with the nuclear model. Consequently, those C³/D aspects described above for the nuclear model have a parallel aspect for the chemical model.

2.4 Ground Combat Model

Ground combat in TACWAR is simulated on a division-level resolution. Personnel and weapon system attrition and subsequent

movement of the forward edge of the battle area (FEBA) are determined as functions of the effectiveness of the divisions of the two combatant sides. Any C³/D within the divisions will affect this combat effectiveness, which will then affect the attrition and FEBA movement. The amount by which C³/D influences overall combat effectiveness of a division can be provided by an explicit functional relationship.

2.5 Theater Control Model

In TACWAR, theater control includes division and airbase resupply, reinforcement, replacement, and reallocation. As in the ground combat model above, reinforcement and replacement for divisions are functions of division combat effectiveness, which is itself influenced by C³/D. Division resupply and reallocation (movement), although strongly dependent on C³/D, have not been modified. Specifically, the gross nature in which TACWAR simulates the movement of entire divisions (and has no capability of modeling movement of division subunits) is not amendable to a C³/D augmentation. As with the air combat model, no C³/D augmentation of airbase resupply and reallocation was attempted within theater control.

3. DETAILS OF C³/D MODIFICATIONS TO TACWAR

The following four major areas of TACWAR have been augmented to include C³/D effects:

- Division combat effectiveness
- Nuclear delivery system availability
- Nuclear escalation state authorization delay
- Nuclear and chemical target acquisition processing delay

In each candidate area for C³/D augmentation to TACWAR, it is necessary to specify C³ equipment or processes that are attrited or degraded. If these C³ assets were to be modeled explicitly in TACWAR, it would be necessary also to specify and to explicitly model the combat by and against these assets. In particular, the augmentation would have to include target acquisition, weapon resource allocation, damage analysis, repair, and reconstitution of the C³ assets.

The modeling effort necessary to include the above effects is beyond the scope of the present work. Consequently, C³ assets are not explicitly included in the C³/D augmentation. Instead, other combat assets that are already incorporated in TACWAR are employed as surrogates for C³ assets. For example, the surrogates for C³ assets within a division will be the different weapons systems of that division. For a corps-sector echelon and theater echelon, the surrogates will be a mix of airbase assets, surface-to-surface missile

(SSM) sites, and surface-to-air missile (SAM) sites. These surrogates will be modified by appropriate weighting factors in the augmentations to realistically reflect the actual mix of C³ assets at the several echelons.

Each of the areas of C³/D augmentation is described in the following sections. The actual FORTRAN code changes and augmentations are in appendix A and are discussed as part of the details below. With this description and appendix A, the interested reader with a minimum of effort may include C³/D effects into a local version of TACWAR.

3.1 Division Combat Effectiveness Augmentation

In TACWAR, each combat division is currently described by effectiveness parameters such as EFFDD(ID) and EFFDA(ID), where ID is the division identifier index. These parameters depend on degradation of weapons systems and personnel in the division (compared with levels given by tables of organization and equipment--TOE), the current supplies available to the division, and the current chemical posture of the division.

For C³/D augmentation, the division combat effectiveness parameters are modified by a C³/D multiplying factor. This multiplying factor is itself determined by a functional relationship between decreased combat effectiveness due to C³/D and decreased division communications (message throughput) capability. Similarly, this decreased division communications capability is determined by a functional relationship between itself and a decrease of C³ assets within the division. Lastly, the decrease in C³ assets is to be determined by using the degradation of surrogate division assets already modeled, these assets being the several weapons systems belonging to the division.

The general flow of logic beginning with degradation of division weapons systems and resulting in a division combat effectiveness C³/D reduction factor is shown in figure 1. The actual changes to the TACWAR code are shown in appendix A and are discussed below.

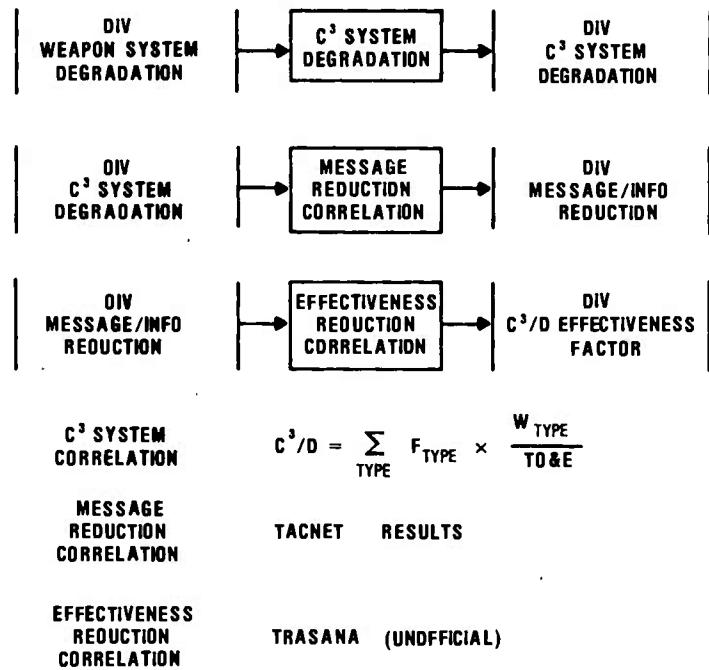


Figure 1. Logic flow algorithm for C^3 degradation of division effectiveness.

Seven new array variables are needed to hold the user input functional relationships and surrogate asset weighting factors. These array variables are consolidated into a common block labeled TNFSC3.

NC3DD(L)
 $L = 1 \text{ to } 2$ contains the number of function pairs XC3DD and YC3DD that describe the functional relationship between the division combat effectiveness C^3/D reduction factor and the decreased division communications capability for each combatant side indexed L.

XC3DD(I,L)
 $I = 1 \text{ to } 8$
 $L = 1 \text{ to } 2$ contains the Ith abscissa point for the function associated with NC3DD(L). The abscissae are fractions of the division communications capability remaining (0.0 corresponding to zero capability and 1.0 corresponding to full capability).

YC3DD(I,L)	contains the Ith ordinate point for the function associated with NC3DD(L). The ordinates are fractional reductions of division combat effectiveness due to C^3/D .
NCOMD(L)	contains the number of function pairs XCOMD and YCOMD that describe the functional relationship between decreased division communications capability and the degradation of division C^3 assets for each combatant side indexed L.
XCOMD(I,L)	contains the Ith abscissa point for the function associated with NC3DD(L). The abscissae are fractions of division C^3 assets remaining (0.0 corresponding to zero assets and 1.0 corresponding to full assets).
YCOMD(I,L)	contains the Ith ordinate point for the function associated with NC3DD(L). The ordinates are fractions of division communications capability remaining (identical to XC3DD).
FCLWL(IW,L)	contains the weighting factors to correlate the division surrogate weapon system indexed IW to an equivalent division C^3 asset. Note: Within the C^3/D modifications to TACWAR, the variables FCLWL are normalized so that the full TOE level of weapons systems in the division corresponds to full C^3 assets. The division C^3 assets calculated by using variable FCLWL are used not only by the division effectiveness augmentation, but also by the nuclear delivery system availability augmentation and the target acquisition processing delay time augmentation described in later sections.

The following subroutines calculate or use division combat effectiveness parameters EFFDD(ID) and EFFDA(ID):

GC	within DO loop 2525
FEBAMT	within DO loop 520
TC	within DO loop 4520 and DO loop 9020
TIMET	following CONTINUE 820

The explicit code changes in these subroutines to incorporate the division effectiveness factor due to C^3/D are given in appendix A.

3.2 Nuclear Delivery System Availability Augmentation

In the TACWAR nuclear model, the nuclear delivery systems available for each combatant side are assembled into three major echelons associated with command control: division, corps-sector, and theater delivery systems. A count is kept of the number of delivery systems available at each echelon for each side. This count of availability is modified by a C³/D reduction factor that reflects the decrease in availability due to a failure to complete special nuclear authorization and release (A/R) messages. The C³/D reduction factor is determined from a functional relationship between the loss of special A/R messages and the degradation of C³ assets within each command control echelon.

The degradation of C³ assets is to be determined by using a weighted degradation of surrogate assets already modeled within TACWAR and associated with each of the three echelons. Specifically, the following assets will be used as surrogates for C³ assets at the different echelons:

Division

Division weapons systems (using the same technique as that described in the previous section for division combat effectiveness)

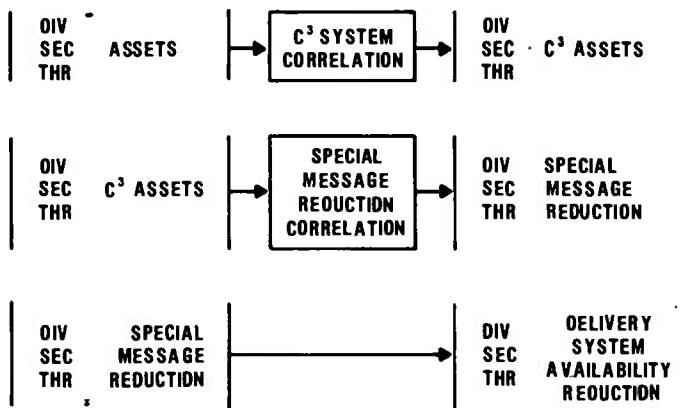
Corps-sector

- Forward sector airbase assets
- Belt SAM sites
- Forward sector medium-range SSM sites
- Forward sector long-range SSM sites

Theater

- Rear sector airbase assets
- Communication zone (COMMZ) airbase assets
- Rear region long-range SAM sites
- COMMZ long-range SAM sites
- Rear sector long-range SSM sites

As these assets are degraded at the several echelons, a weighted proportion is assumed to correspond to the degradation of C³ assets within the same echelon. The general flow of logic beginning with the degradation of explicitly modeled echelon assets and resulting in the C³/D factor for the availability of nuclear delivery systems at that echelon is shown in figure 2.



DIV ASSETS: DIVISION WEAPONS
 SEC ASSETS: FORWARD AIRBASES
 BELT SAM'S
 MEDIUM RANGE SSM'S
 LONG RANGE SSM'S (FORWARD)
 THEATER ASSETS: REAR AND COMMZ AIRBASES
 REAR AND COMMZ SAM'S
 LONG RANGE SSM'S (REAR)

$$C^3 \text{ SYSTEM } C/D = \sum_{\text{ASSET}} F_{\text{ASSET}} \times \left(\frac{W_{\text{CUR}}}{W_{\text{INIT}}} \right)_{\text{ASSET}}$$

*AIRBASE ASSETS DYNAMICALLY ADJUSTED

Figure 2. Logic flow algorithm for C^3 degradation of nuclear delivery system availability.

The changes necessary in TACWAR to include the degradation of nuclear delivery system availability as a result of C^3/D are given in appendix A and are discussed below.

Twenty-one new array variables are required to hold the user input functional relationships, the surrogate asset weighting factors, the initial numbers of explicitly modeled echelon assets, and the nuclear delivery system degradation factors. The array variables are consolidated in two common blocks labeled TNFSC1 and TNFSC2.

INABF(IS,L) contains the initial number of forward area
 IS = 1 to 8 airbases in sector indexed IS for combatant side
 L = 1 to 2 indexed L.

INABR(IS,L) contains the initial number of rear area airbases
 IS = 1 to 8 in sector indexed IS for side indexed L.
 L = 1 to 2

INABZ(L) contains the initial number of COMMZ airbases for
 L = 1 to 2 side indexed L.

NC3SD(L) contains the number of function pairs XC3SD and
 L = 1 to 2 YC3SD that describe the functional relationship
 between the fractional degradation of nuclear
 delivery system availability and the degradation
 of C³ assets at each echelon for combatant side
 indexed L.

XC3SD(I,L) contains the Ith abscissa point for the function
 I = 1 to 8 associated with NC3SD(L). The abscissae are
 L = 1 to 2 fractions of C³ assets remaining in a particular
 echelon.

YC3SD(I,L) contains the Ith ordinate point for the function
 I = 1 to 8 associated with NC3SD(L). The ordinates are
 L = 1 to 2 fractional reductions in nuclear delivery system
 availability at a particular echelon.

FDDSAD(IS,L) contains the current C³/D fractional reduction in
 IS = 1 to 8 the nuclear delivery system availability for the
 L = 1 to 2 division echelon in sector IS for side L.

FSADSAD(IS,L) contains the current C³/D fractional reduction in
 IS = 1 to 8 nuclear delivery system availability for the
 L = 1 to 2 corps-sector echelon in sector IS for side L.

FTDSAD(IS,L) contains the current C³/D fractional reduction in
 IS = 1 to 8 nuclear delivery system availability for the
 L = 1 to 2 theater echelon in sector IS for side L.

FABDCC(L) contains the weighting factor to correlate the
 L = 1 to 2 corps-sector and theater C³ assets with
 surrogate airbase assets located within the two
 respective echelons for side L.

ABSFCC(IS,L) contains the fractional asset degradation of a
 IS = 1 to 8 notional (average) airbase in the forward area
 L = 1 to 2 of sector IS for side L.

ABSRCC(IS,L) contains the fractional asset degradation of a notional airbase in the rear area of sector IS for side L.
 IS = 1 to 8
 L = 1 to 2

ABCZCC(L) contains the fractional asset degradation of a notional airbase in the COMMZ for side L.
 L = 1 to 2

FSSMCC(L) contains the weighting factor to correlate the corps-sector and theater C³ assets with surrogate SSM sites located within the two respective echelons for side L.
 L = 1 to 2

TSSMIR(IS,L) contains the initial number of theater echelon long-range SSM sites located in the rear area of sector IS for side L. TSSMIR is set to the initial value of the variable SSMSRS(IS,L) already incorporated in TACWAR.
 IS = 1 to 8
 L = 1 to 2

SSSMIM(IS,L) contains the initial number of corps-sector echelon medium-range SSM sites in the forward area of sector IS for side L. SSSMIM is set to the initial value of the variable SSMSFS (1,IS,L) already incorporated in TACWAR.
 IS = 1 to 8
 L = 1 to 2

SSSMIL(IS,L) contains the initial number of corps-sector echelon long-range SSM sites in the forward area of sector IS for side L. SSSMIL is set to the initial value of the variable SSMSFS (2,IS,L) already incorporated in TACWAR.
 IS = 1 to 8
 L = 1 to 2

FSAMCC(L) contains the weighting factor to correlate the corps-sector and theater C³ assets with surrogate SAM sites located within the two respective echelons for side L.
 L = 1 to 2

TSAMIR(IR,L) contains the initial number of theater echelon long-range SAM sites in the rear area of region IR for side L. TSAMIR is set to the initial value of the variable ALRSR(1,IR,L) already incorporated in TACWAR.
 IR = 1 to 3
 L = 1 to 2

TSAMIZ(L) contains the initial number of theater echelon long-range SAM sites in the COMMZ for side L. TSAMIZ is set to the initial value of variable ALRSZ(1,L) already incorporated in TACWAR.
 L = 1 to 2

SSAMIF(IR,L) contains the initial number of corps-sector echelon belt SAM sites in the forward area of region IR for side L. SSAMIF is set to the initial value of variable BMRS(1,IR,L) already incorporated in TACWAR.

In addition to the new array variables described above, two new subroutines have been created as part of the C³/D augmentation of nuclear delivery system availability. These two subroutines, named DSDEG and NUCCCD, are given in appendix A and are briefly described below.

Subroutine DSDEG calculates the fractional decrease in the availability of nuclear delivery systems controlled by the three echelons for each sector IS and for each side L. These fractional values are stored in variables FTDSAD, FSDSAD, and FDDSAD for later use by subroutine NWHINV. The calculations are performed by using the following algorithm:

- Determine the SAM region IR associated with sector IS.
- Adjust the surrogate weighting factors for airbase assets as required.
- Determine the fractional C³ equipment degradation from the weighted fractional degradation of the surrogate at each echelon.
- Determine the fractional degradation of the nuclear delivery system availability at each echelon from the functional relationship between the decrease in availability and the degradation of the echelon C³ assets.

In addition, subroutine DSDEG holds the calculated corps-sector and theater C³ asset degradation for use in the nuclear escalation state authorization delay and target acquisition processing delay augmentations described in later sections.

One special procedure in DSDEG should be noted on the calculation for the division echelon C³ assets. The total degradation of C³ assets for this echelon is taken as the geometric mean of both the corps-sector and the division C³ degradation. This procedure more realistically simulates the corps-to-division C³ measures actually used.

Subroutine NUCCCD determines the current values of the airbase assets for forward area, rear area, and COMMZ notional airbases for each sector IS and for each side L. These airbase assets are stored in array variables ABSFCC, ABRSCC, and ABCZCC, respectively. They are calculated from the current values of the operation capability OCNUC(IAB) of the

actual airbases comprising the notional, where IAB is the index identifying the actual airbase.

Much of the code for subroutine NUCCCD is extracted from subroutine DEG (already a part of TACWAR) that performed a similar function using variable OCNUC(IAB). Moreover, to correctly determine the operating capability of each actual airbase, the variable OCNUC is now computed in subroutine DAMEVL. Subroutine NUCCCD also performs the task of initializing the variables INABF, INABR, and INABZ.

Subroutines DSDEG and NUCCCD are called once every nuclear or chemical subcycle from subroutine TMAIN. The results from DSDEG are used in subroutine NWHINV to make the actual modifications to the nuclear delivery system availability variables due to C^3/D .

3.3 Nuclear Escalation State Authorization Delay Augmentation

Presently in TACWAR, depending on the current tactical status, immediate escalation to a combat state may occur in which nuclear and chemical weapons can be used. This ability to escalate instantaneously is typically not a faithful nuclear combat simulation since it precludes the proper authorization by high-level authorities for each combatant side. Consequently, TACWAR has been modified to simulate the nuclear request and authorization procedures as a processing and decision-making delay time between the time that a nuclear escalation state is desired within a sector (as a function of the current tactical status of that sector) and the time that the escalation can, in fact, occur. This processing delay time is a function of C^3/D occurring for each side, especially in the theater and corps-sector echelons of the battlefield.

The changes necessary in TACWAR to include the nuclear escalation processing delay as a result of C^3/D are given in appendix A and are discussed below.

Nine new array variables are required to hold the user input functional relationships, the theater and corps-sector C^3 assets, and the escalation state processing flags. These array variables are consolidated in a common block labeled TNFSC4.

NEDLY(L)
L = 1 to 2

contains the number of function pairs XEDLY and YEDLY that describe the functional relationship between the fractional degradation of C^3 assets in the theater and corps-sector echelons and the processing delay time for nuclear escalation for combatant side L.

XEDLY(I,L)	contains the Ith abscissa point for the function associated with NEDLY(L). The abscissae are fractions of C ³ equipment assets remaining in a theater or corps-sector echelon for side L.
YEDLY(I,IF,L)	contains the Ith ordinate point for two functions (IF = 1 and IF = 2) associated with NEDLY(L). The ordinate is nuclear A/R processing times (in hours) for each side L. The function corresponding to IF = 1 describes the delay time associated with the first A/R cycle for each side L and typically reflects the enhanced decision-making delay for first use of nuclear weapons. The function corresponding to IF = 2 describes the delay time associated with all A/R cycles following the first.
JESC(IS,ITC,L)	contains the desired escalation state for side L within sector IS against target category ITC. This variable will reflect the nuclear escalation state to which side L will advance following the completion of the required processing delay.
IWAUT(IS,L)	contains the control flags that are set whenever side L within sector IS is waiting for nuclear release authorization.
IFPLS(IS,L)	contains the control flags that are set following the first authorization to a nuclear state by side L in sector IS.
TEQPD(L)	contains the current fractional decrease in theater C ³ assets for side L. These variables are determined from the identical surrogate theater assets described in section 3.2 for the degradation of nuclear delivery system availability.
SEQPD(IS,L)	contains the current fractional decrease of corps-sector C ³ assets within sector IS for side L. These variables are determined from identical surrogate corps-sector assets used for the degradation of nuclear delivery system availability.

CTIME(IS,L) contains the current waiting time (in hours) following the onset of a nuclear escalation request by side L in sector IS. This time is updated every nuclear or chemical subcycle until the appropriate delay has been achieved.

IS = 1 to 8

L = 1 to 2

In addition to the nine new array variables, one new subroutine, named EDELAY, has been created as part of the augmentation to delay the nuclear escalation process. EDELAY is given in appendix A and is briefly described below.

EDELAY uses the above array variables to calculate and update a processing delay time and the current waiting time before a desired nuclear escalation state can be realized by each side in each combat sector IS. EDELAY uses an algorithm shown in the flow diagram in figure 3. Specifically, for each side and for each sector,

- Calculate the fractional C^3 equipment assets (associated with nuclear A/R) degraded in each sector. These assets correspond to the geometric mean of the theater and corps-sector echelon C^3 assets since the authorization process occurs through a theater to corps-sector chain of command.
- Determine the desired escalation state.
- If not already waiting, reset the waiting time and set the waiting flag.
- Determine the current delay time as a function of C^3/D .
- Update the current waiting time.
- If the waiting period is complete, set the current escalation state to the desired state, reset the waiting flag, and reset the desired escalation state.

EDELAY is called from subroutine NUC1 immediately following the call to ESCLAT.

3.4 Nuclear or Chemical Target Acquisition Processing Delay

Presently in TACWAR the target acquisition (TA) model provides for the acquisition by each combatant side against active and reserve division subunit targets of the opposite side. Using ground sensor, army-air sensor, and air force sensor assets, the following three quantities are determined against each target type:

Total probability of detection by all available TA assets
 Root-mean-square TA error
 Weighted average processing time for TA information

The first two quantities are primarily functions of the number and operating characteristics of the TA sensors and are negligibly influenced by C³/D. However, the third quantity, TA processing time, is greatly influenced by C³/D. Consequently, TACWAR is augmented to include the increase in TA processing time due to the degradation of C³ assets within the area where the TA sensors are controlled. This additional processing time is then added to the nominal processing time (already a part of TACWAR) to give a total processing time for the TA information against each target type.

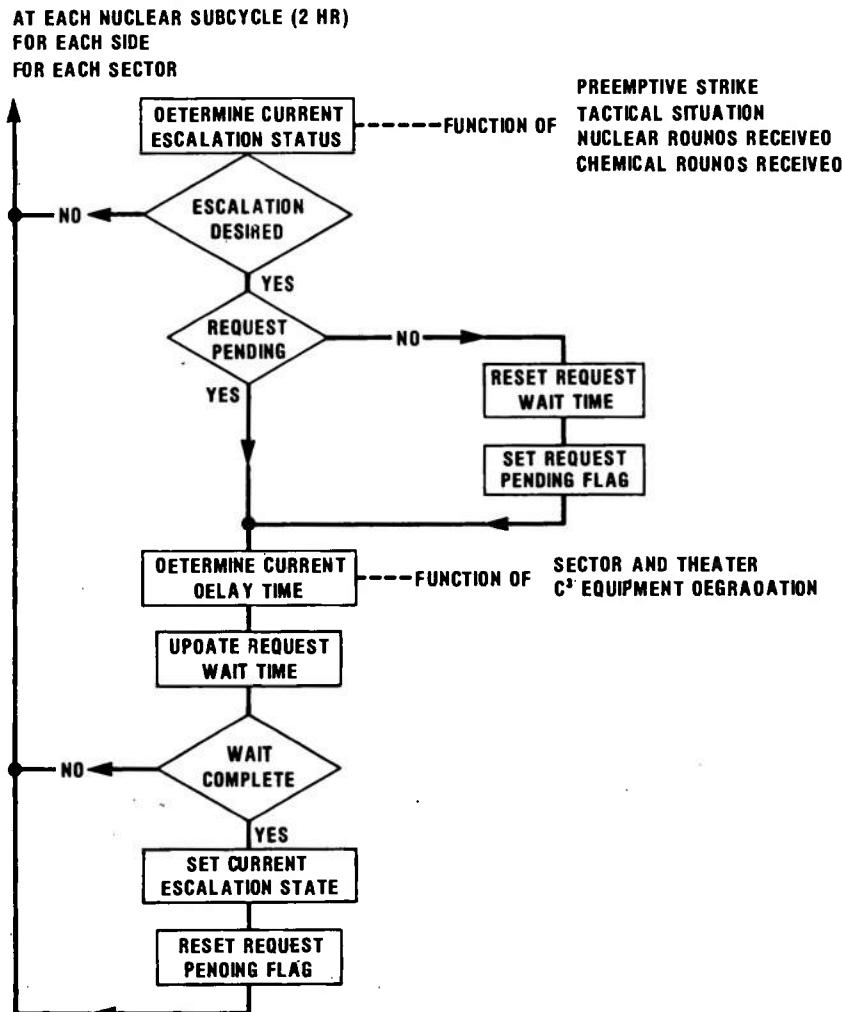


Figure 3. Logic flow diagram of C³ degradation of nuclear escalation process.

In TACWAR, the TA processing time currently calculated is not effectively used by the other subroutines of TACWAR. In particular, the TA processing time becomes an important quantity in the overall combat simulation when the simulation also includes movement of the targets. Thus, if TA processing is excessively long against an acquired target, then that potential target may move to another location before being attacked by nuclear or chemical munitions. The effects of subsequent nuclear or chemical strikes would then be partially or completely negated. Since TACWAR presently has no simulation of the movement of subunit targets and does not use the TA processing times against these subunit targets, the effects of C^3/D , especially as they modify TA processing times, will have minimal impact on the outcome of the combat simulation. Consequently, it is recommended that TACWAR be modified to include the necessary target subunit movement capability. However, such a modification would be outside the scope of this work.

The changes necessary in TACWAR to include the nuclear or chemical TA processing delay as a result of C^3/D are given in appendix A and are described below.

Nine new array variables are required to hold the user input functional relationships between C^3 equipment degradation and increased TA processing times. These array variables are consolidated in a common block labeled TNFSC5.

NGSFD(L) L = 1 to 2	contains the number of function pairs XGSFD and YGSFD that describe the functional relationship between the increase in the TA processing time for division ground sensors and the degradation of division C^3 assets for side L.
XGSFD(I,L) I = 1 to 8 L = 1 to 2	contains the Ith abscissa point for the function associated with NGSFD(L). The abscissae are fractions of C^3 assets remaining in a division.
YGSFD(I,L) I = 1 to 8 L = 1 to 2	contains the Ith ordinate point for the function associated with NGSFD(L). The ordinates are increased TA processing times (in hours) for the division ground sensors for side L.
NAAFD(L) L = 1 to 2	contains the number of function pairs XAAFD and YAAFD that describe the functional relationship between the increase in the TA processing time for army-air sensors and the

	degradation of forward corps-sector C^3 assets for side L.
XAAFD(I,L) I = 1 to 8 L = 1 to 2	contains the Ith abscissa point for the function associated with NAAFD(L). The abscissae are fractions of C^3 assets remaining in the forward corps-sector of side L.
YAAFD(I,L) I = 1 to 8 L = 1 to 2	contains the Ith ordinate point for the function associated with NAAFD(L). The ordinates are increased TA processing times (in hours) for army-air sensors for side L.
NAFFD(L) L = 1 to 2	contains the number of function pairs XAFFD and YAFFD that describe the functional relationship between the increase in the TA processing time for air force sensors and the degradation in the forward region C^3 assets for side L.
XAFFD(I,L) I = 1 to 8 L = 1 to 2	contains the Ith abscissa point for the function associated with NAFFD(L). The abscissae are fractions of C^3 assets remaining in the forward region of side L (as determined by the average of the fractional C^3 assets remaining in the corps-sectors that comprise the region).
YAFFD(I,L) I = 1 to 8 L = 1 to 2	contains the Ith ordinate point of the function associated with NAFFD(L). The ordinates are increased TA processing times (in hours) for air force sensors for side L.

The three functional relationships given above describe the influence of C^3/D on TA processing times for each of the three types of TA assets--ground, army-air, and air force, respectively. The degradation of C^3 assets within each of the three areas that control these different TA assets is calculated in a manner identical for that of the earlier sections. Specifically, the degradation of divisional C^3 assets that control the ground sensors is determined from surrogate weapons systems assets as described in section 3.1. Similarly, the degradation of C^3 assets that control army-air sensors in corps-sector IS = 1 to 8 is contained in the array variable SEQPD described in section 3.3. The degradation of C^3 assets that control air force sensors in regions IR = 1 to 3 is determined as an average of the C^3 asset degradations (SEQPD) for all corps-sectors comprising the regions.

In sections in subroutines TADPAR and TARACA (already a part of TACWAR), the above functions are used and the increase in TA processing times is calculated (app A).

3.5 Ancillary Modifications to TACWAR

In addition to the modifications described in sections 3.1 to 3.4, several ancillary modifications are required in TACWAR to support the above modifications. Specifically, a user data input subroutine, named TNFIMP, and a data initialization BLOCK DATA subroutine have been created to initialize the array variables described in sections 3.1 to 3.4. Both TNFIMP and the BLOCK DATA subroutines are given in appendix A. Also, the single call to subroutine TNFIMP is made at the beginning of subroutine TMAIN.

4. LIMITATIONS

In constructing the augmentations to TACWAR described in section 3, no attempt was made to minimize the additional required storage to hold the new data variables and code. In particular, no overlay structure was developed that would conform to that of the later versions of TACWAR.* Similarly, the data for the new variables are input through a rather rudimentary set of READ instructions in subroutine TNFIMP, and no attempt was made to include this data input into the rather extensive input phase of TACWAR. One consequence of this is that the augmentations do not support the "restart" capability described by the Defense Communications Agency.^t Another consequence is the requirement for the augmented data to be in a definite sequence for proper interpretation by subroutine TNFIMP.

5. USER DATA INPUT

For the most part, the user data necessary to initialize the new array variables (sect. 3) are (1) the weighting factors used to transform an explicitly modeled area asset into an equivalent C³ asset for the same area or echelon and (2) the functional relationships describing the influence of C³/D on the several combat simulations.

The surrogate assets for the division level C³ equipment are the weapons systems within the divisions (up to 10 such system types are allowed for each division). An initial approximation would be to assume

*TACWAR Core Reduction, Defense Communications Agency CCTC Letter Report, Task Order 634 Subtask 1 (17 April 1978).

^tTACWAR Restart Capability, Defense Communications Agency CCTC Letter Report, Task Order 534 Subtask 2 (14 December 1977).

that one C³ asset is associated with each weapons system; thus, the weighting factors for division C³ assets would be the initial number of weapons systems at the beginning of the simulation for each combatant side. These, in fact, are the weighting factors used in the examples of section 6. However, it is probably a better simulation of reality to assume one C³ asset (in arbitrary units) to each division subunit. The number of weapons systems in each of the subunit types would then determine the appropriate C³ asset weighting factor.

The surrogate assets for corps-sector and theater C³ equipment are airbase assets, SSM assets, and SAM assets. The weighting factors to transform these into equivalent C³ assets may be determined by the following rationale. Airbase assets may be roughly equated with fixed-site hardened C³ facilities; SSM sites may be roughly equated with mobile nuclear "soft" C³ assets; SAM sites may be roughly equated with semimobile nuclear hardened C³ assets. The appropriate mix of the group will depend upon the specific theater of conflict. For the examples given in section 6, the following corps-sector and theater weighting factors are used for each side:

Airbase	0.30
SSM	0.40
SAM	0.30

The functional relationships between C³/D and the several aspects of the augmentations are provided according to the following assumptions:

a. The functional relationship between the degradation of division-level C³ assets and the reduction of division-level messages is obtained from the results of TACNET (a discrete event simulation of a theater-level communications model developed by Egon Marx²). The explicit relationship is shown in figure 4 and assumed applicable for each side.

b. The functional relationship between the reduction of division-level message traffic and the decreased division effectiveness is obtained from consultation with personnel at the U.S. Army Training and Doctrine Command (TRADOC) Systems Analysis Activity (TRASANA). This relationship is shown in figure 5 and is assumed applicable for each side.

c. The functional relationship between the degradation of corps-sector and theater C³ assets and the reduction of "special" messages associated with the availability of nuclear delivery systems was taken from the Marx report.² This relationship is shown in figure 6 and is assumed applicable for each side.

²Egon Marx, TACNET, A Model of the Army's Tactical Communications Networks in Europe, Harry Diamond Laboratories HDL-TR-1913 (January 1980).

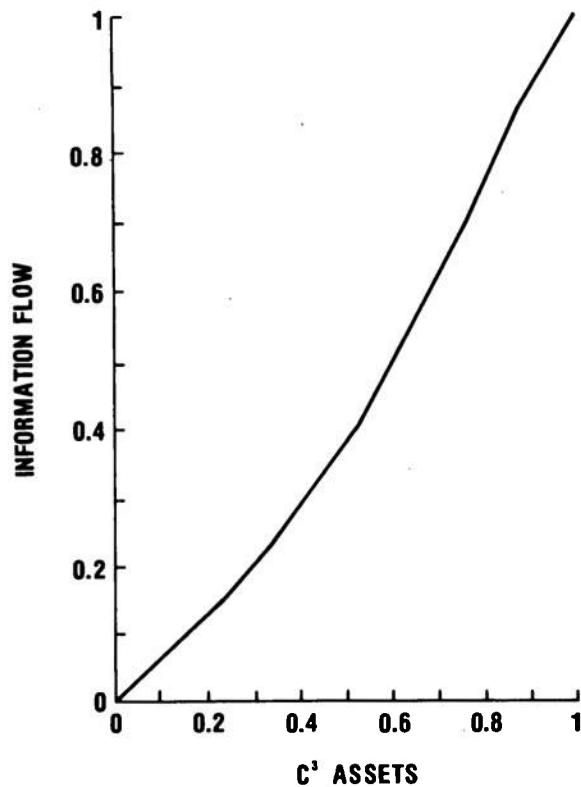
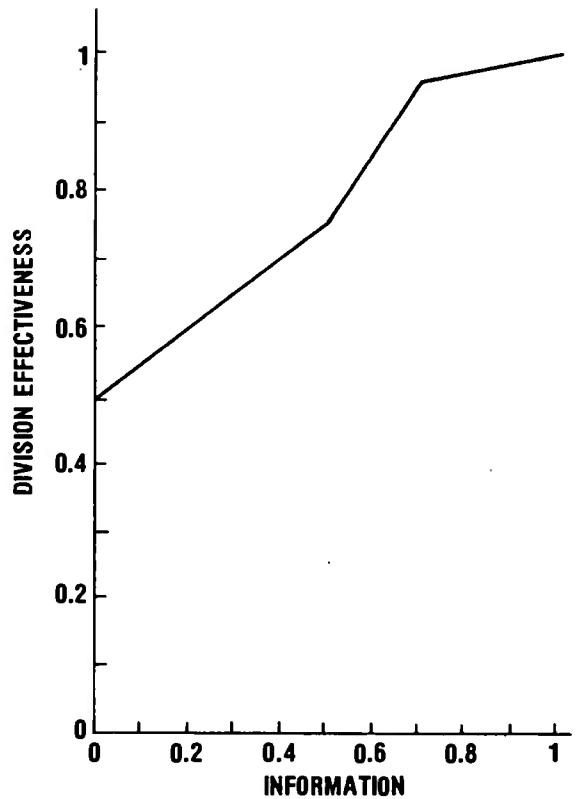


Figure 4. Fraction of information available within division as function of fraction of C^3 assets remaining within division.

Figure 5. Division effectiveness as function of fraction of information messages available within division.



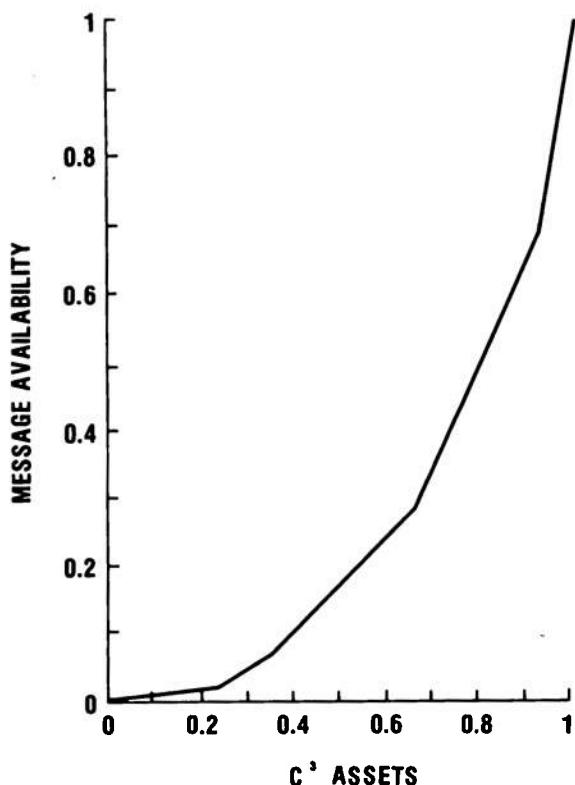


Figure 6. Fraction of nuclear authorization and release messages available as function of remaining C³ assets.

d. The functional relationships between the degradation of corps-sector and theater C³ assets and the nuclear escalation authorization delay times are shown in figure 7(a, b) for side L = 1 (blue) and side L = 2 (red). These data are initial estimates used to exercise the augmentations more than for accurate representations of reality.

e. The functional relationships between the degradation of division, corps-sector, and regional C³ assets and the increased TA processing time are shown in figure 8(a, b, c) and are assumed applicable for each side. These data are primarily to exercise the augmentations.

Figure 9 illustrates a sample data deck used as input for subroutine TNFINP described in section 3.5. It is imperative that the data cards follow in correct sequence.

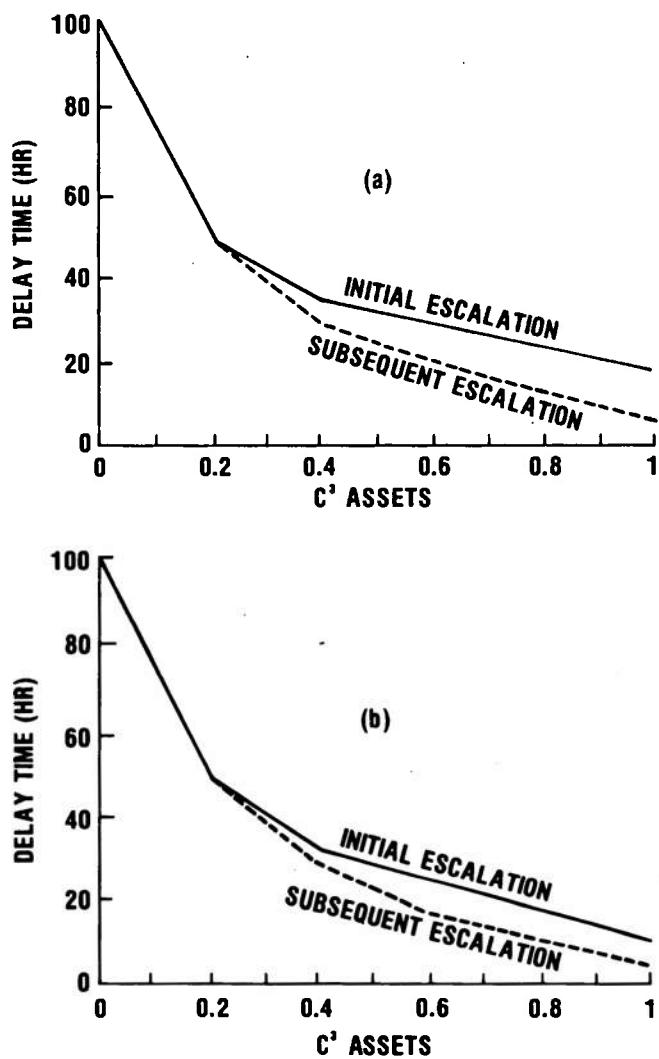


Figure 7. Nuclear escalation delay time as function of remaining C^3 assets: (a) blue side and (b) red side.

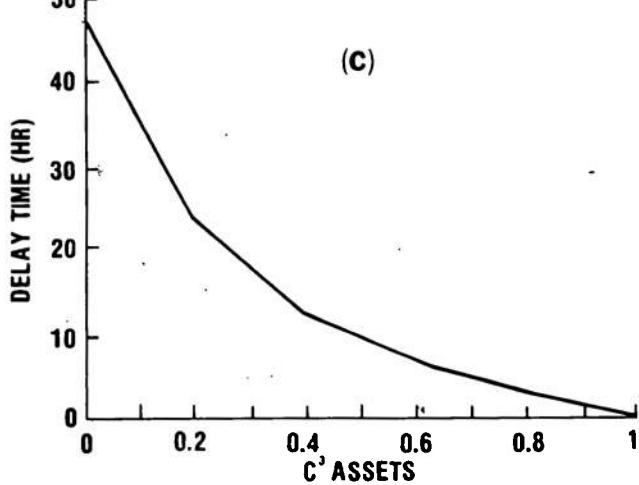
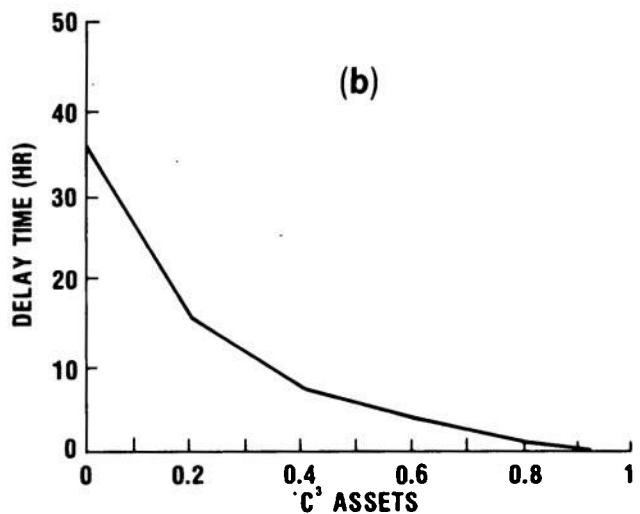
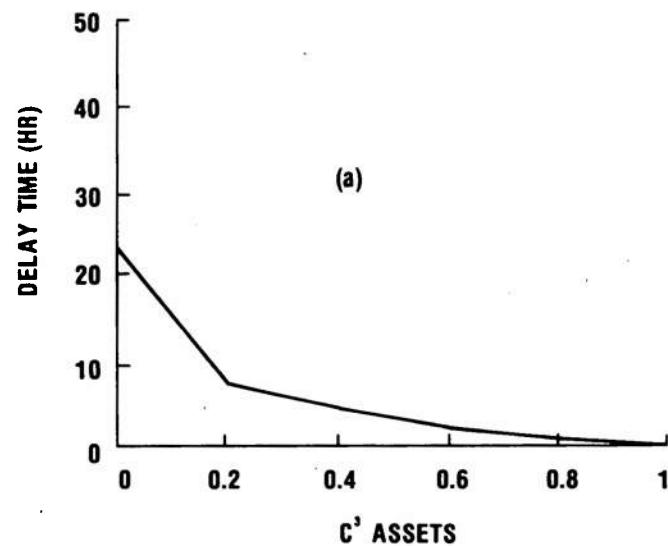


Figure 8. Target acquisition delay time as function of remaining C^3 assets: (a) ground sensors, (b) army-air sensors, and (c) air force sensors.

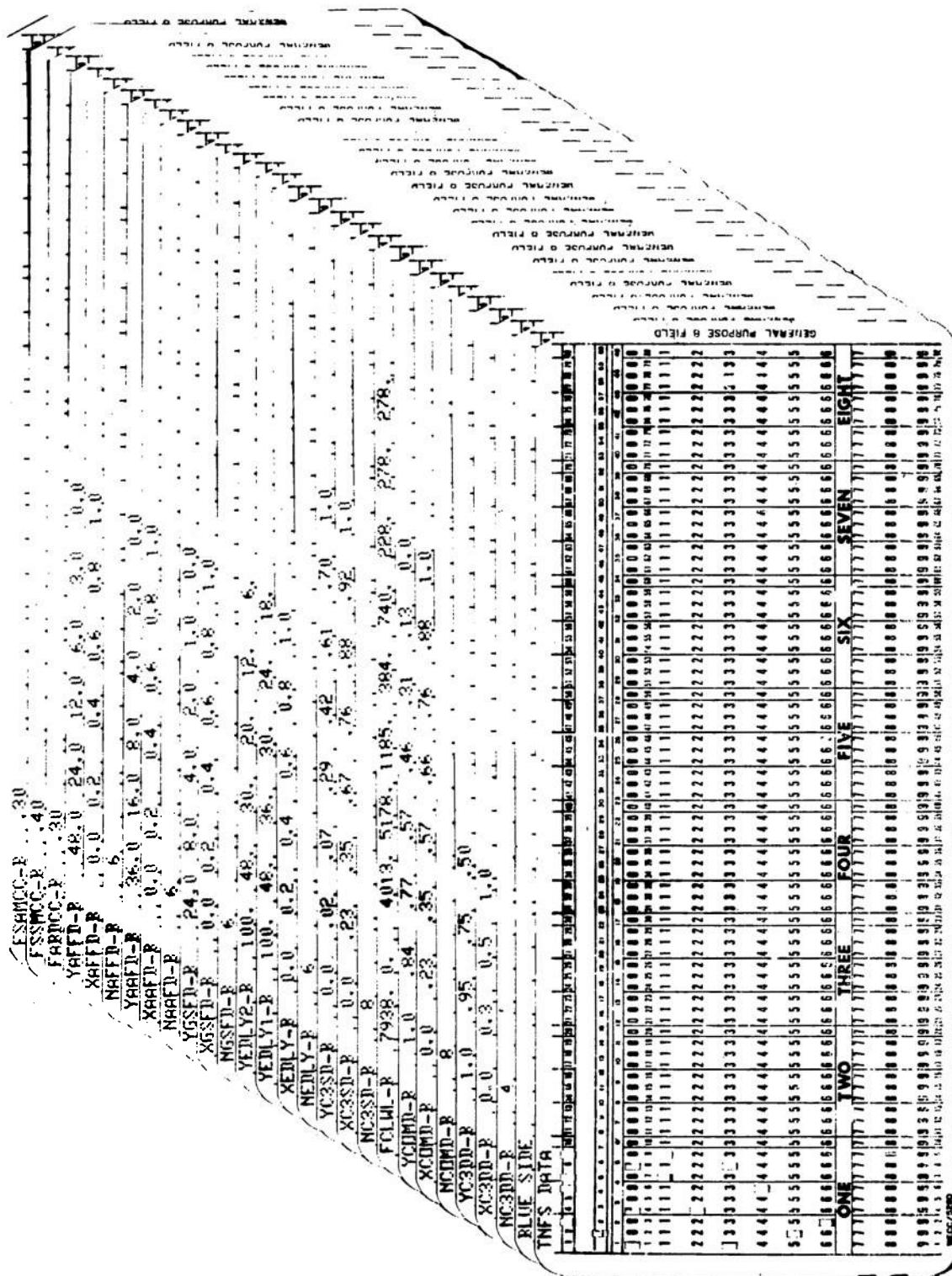


Figure 9. TNFINP input data.

Figure 9. TNF INP input data (Cont'd).

6. RESULTS OF SAMPLE RUNS

The C³/D modified TACWAR model has been exercised for several sets of input data to validate the augmentations described in section 3 and to determine the degree of sensitivity of the overall combat simulation to these augmentations. These sample simulation runs were made by using an unclassified benchmark data base obtained from CCTC. For the different sample runs, the values of the parameters in this data base remained constant except those parameters used to control the overall operation of the simulation such as the total number of 12-hr cycles involved and the inclusion of nuclear combat capability. The additional parameters associated with the C³/D augmentation were varied from run to run in order to make the sensitivity determination.

Although the parameters in the benchmark data base and the parameters associated with C³/D augmentation are reasonable, they are not necessarily an accurate reflection of current combat capabilities of U.S. or adversary forces. Consequently, the results of the sample runs have no direct significance in an actual environment.

6.1 Conventional Warfare--Influence of C³/D on Division Effectiveness

The first series of sample runs involved opposing forces constrained to conventional warfare only, with no possibility of nuclear or chemical escalation. These runs were used to exercise the C³/D augmentation to division effectiveness and subsequent combat results such as weapon system losses, personnel casualties, and FEBA movement. The sample runs included two cases:

- Side 1 (blue) alone suffers C³/D.
- Side 2 (red) alone suffers C³/D.

The simulations were run for twenty-five 12-hr cycles (12.5 days), and detailed results were obtained for all eight sectors of the theater. However, the results of only a typical sector (sector 6) were subjected to a detailed analysis.

Figure 10 shows the personnel casualties incurred by side 1 (blue) in sector 6 for the two cases. If only the last values of the casualties had been given for analysis instead of the entire time history, one might have logically concluded that the results disagreed with practical intuition. Specifically, after cycle 14, the blue casualties are less when the blue side suffers C³/D than when the red side suffers C³/D. However, a more detailed analysis of the entire picture of the combat resolves this apparent contradiction. Thus, when the blue side alone suffers C³/D, the red side at the beginning of the

simulation becomes the sector attacker and maintains this attack posture throughout the entire simulation. The blue side (defending) assumes several different defense postures such as delay, prepared defense, hasty defense, and breakthrough, as shown in figure 10. Each of these defense postures has a different personnel attrition rate associated with it, which is the major cause of the abrupt change in slope in the figure. On the other hand, when the red side alone suffers C^3/D , it again begins the simulation as the sector attacker. However, after cycle 14, the red side stops attacking and shifts to a holding posture; the blue side likewise shifts from defense to holding. Since the personnel attrition rate for a holding posture is greater than that for the delay defense posture, the blue casualty lines for the two cases cross shortly after cycle 14, and the apparent inconsistency is explained. Consequently, it is advisable when analyzing the results of TACWAR simulations (including those associated with C^3/D augmentation) not to reject as wrong or in error any result that, on the surface, appears to contradict logical intuition.

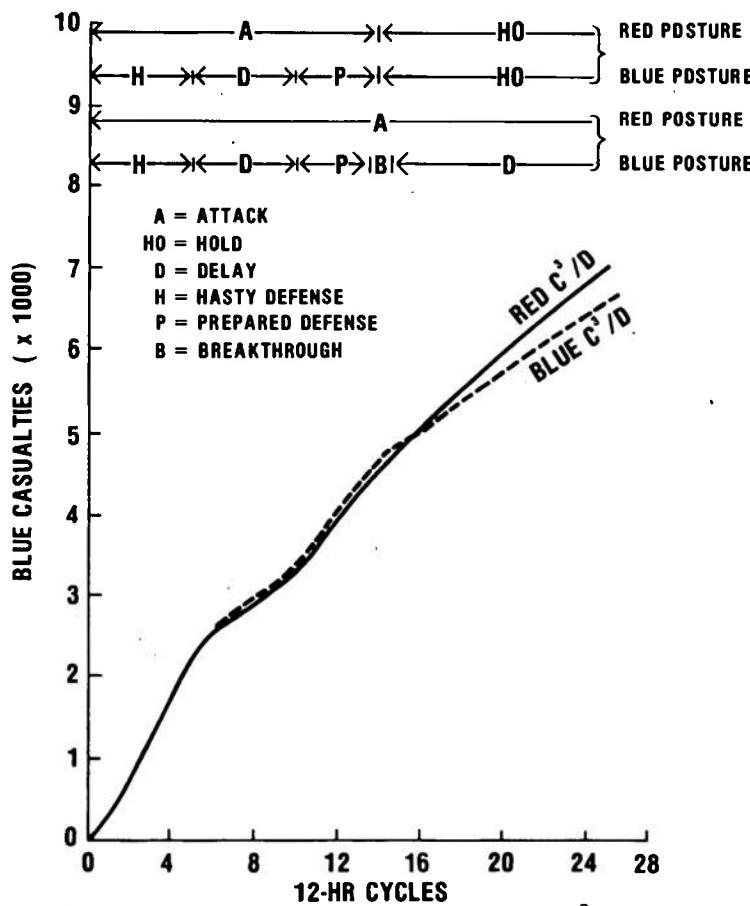


Figure 10. Blue casualties for C^3/D reduction of division effectiveness.

Figure 11 shows the counterpart casualties incurred by side 2 (red) for the two cases. For this situation, there is no inconsistency in what is to be intuitively expected (at least to the point where the simulation run was ended). These results show approximately a 10-percent maximum difference for the two extreme cases of C^3/D , that is, blue alone versus red alone.

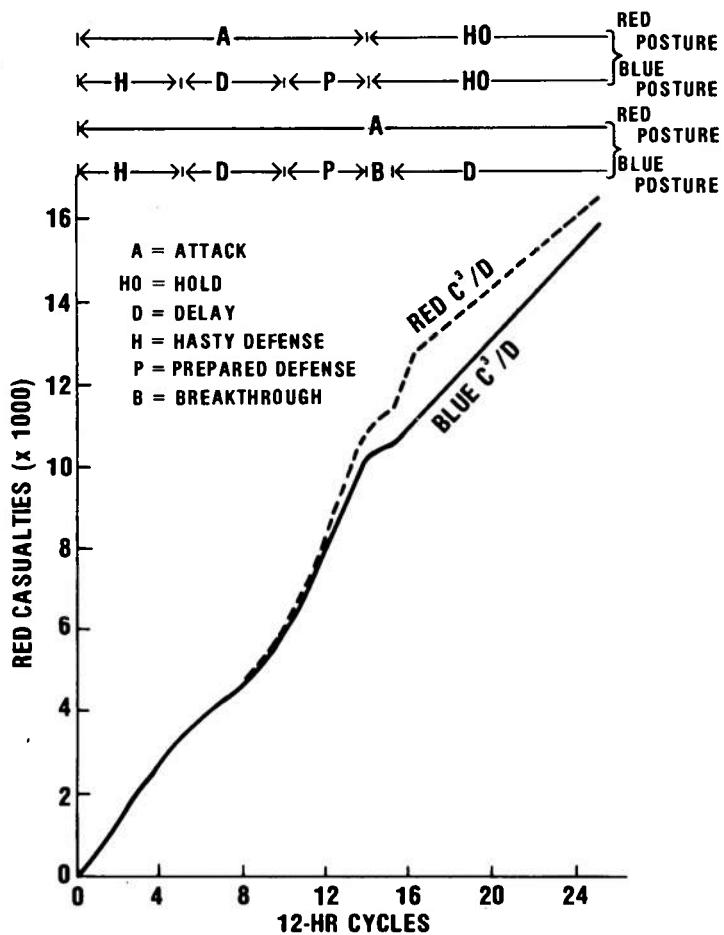


Figure 11. Red casualties for C^3/D reduction of division effectiveness.

Figure 12 shows the relative FEBA movement in sector 6 for the two cases. This figure illustrates the fact that C³/D can dramatically affect some of the results of combat. The detailed analysis of all aspects of the simulation is required for full understanding of the reason for this behavior. Thus, with blue alone suffering C³/D, the red side maintains its attack posture throughout the simulation. After cycle 14, when the blue side assumes a delay defensive posture and the terrain interval allows a fast FEBA movement, the slope of the FEBA movement line abruptly increases. On the other hand, when the red side alone suffers C³/D, its attack stalls after cycle 14, and the FEBA movement does not increase further.

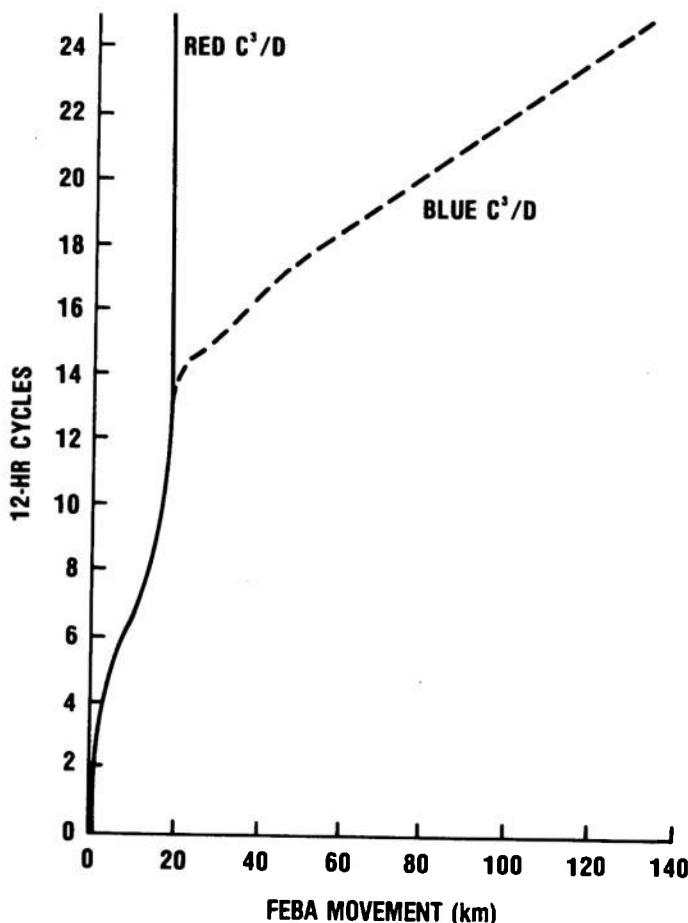


Figure 12. Forward edge of battle area movement for C³/D reduction of division effectiveness.

6.2 Nuclear Warfare--Influence of C³/D on Nuclear Delivery System Availability

The next series of sample runs involved opposing forces engaged in a combined conventional and nuclear warfare environment. Nuclear warfare was played by assuming that a new escalation state could be initiated every 12-hr cycle. As a consequence of the benchmark data base used, a restricted set of escalation criteria was used in the sample runs. Specifically, preemptive strike escalation was allowed from cycle 0 through cycle 4. Following cycle 4, the only criterion for allowed nuclear escalation was the FEBA movement past a critical threshold. Consequently, the number of nuclear escalation attempts was limited for both sides.

As in section 6.1, sample runs included simulations in which side 1 (blue) alone suffered C³/D and in which side 2 (red) alone suffered C³/D. The simulations were run to twenty 12-hr cycles (10 days), and detailed results were obtained for all eight sectors of the theater. Again only sector 6 was analyzed in detail.

Figures 13 to 15 show the fraction of nuclear delivery system availability due to C³/D for division, corps-sector, and theater echelons, respectively. The strong decrease in the availability of corps-sector delivery systems reflects the active nuclear combat being played as a result of preemptive attacks. After cycle 4, the change is much slower because only conventional warfare is being waged during this time. The changes occurring at cycle 14 are due to reallocation of assets from the theater to the corps-sector echelon. The availability of theater delivery systems shows a more gradual decrease due primarily to conventional attrition by aircraft attack. Lastly, the decrease to zero of the blue side division availability between cycles 8 and 16 is an "artifact" resulting when the supplies inventory for the blue divisions is depleted and the divisions are forced to withdraw out of the active battle area. When new supplies are allocated to these divisions, they again achieve a finite delivery system availability.

In conclusion, although the availability factors within each echelon are strongly influenced by C³/D, the total number of nuclear rounds fired by each side remained essentially the same as when no C³/D occurred for either side. They are similar because of the large number of potential delivery systems available at each echelon and the restricted nuclear combat being played; that is, the number of potential nuclear targets remained small with or without C³/D.

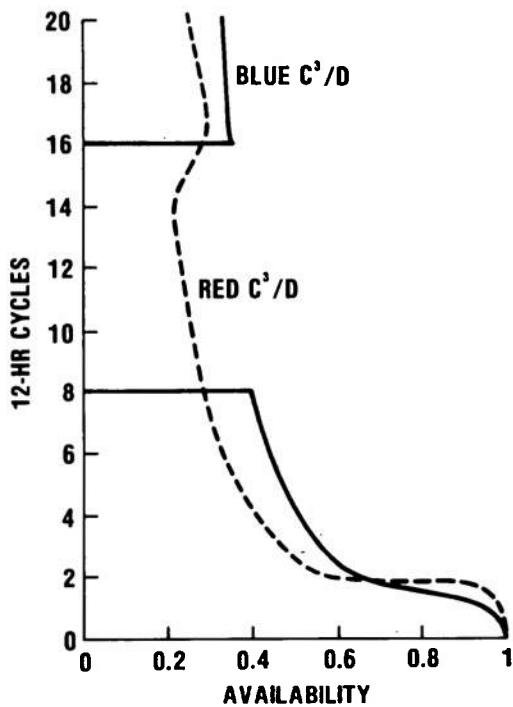
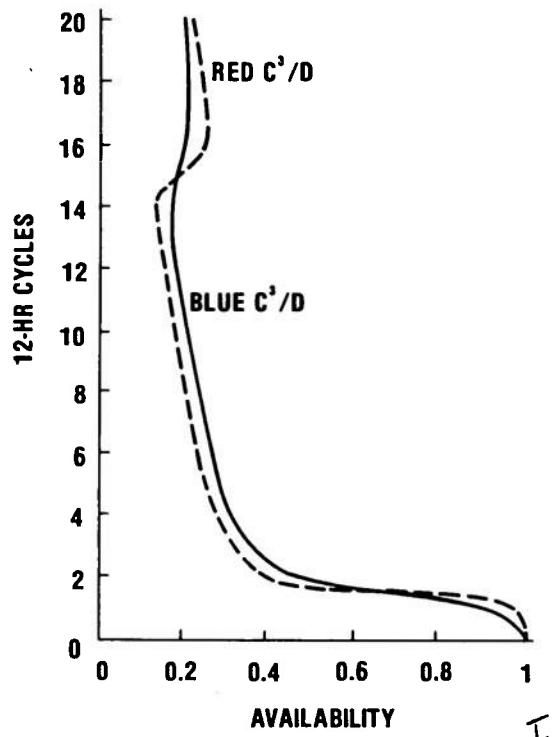


Figure 13. Reduced nuclear delivery system availability for division echelon due to C³/D.

Figure 14. Reduced nuclear delivery system availability for corps-sector echelon due to C³/D.



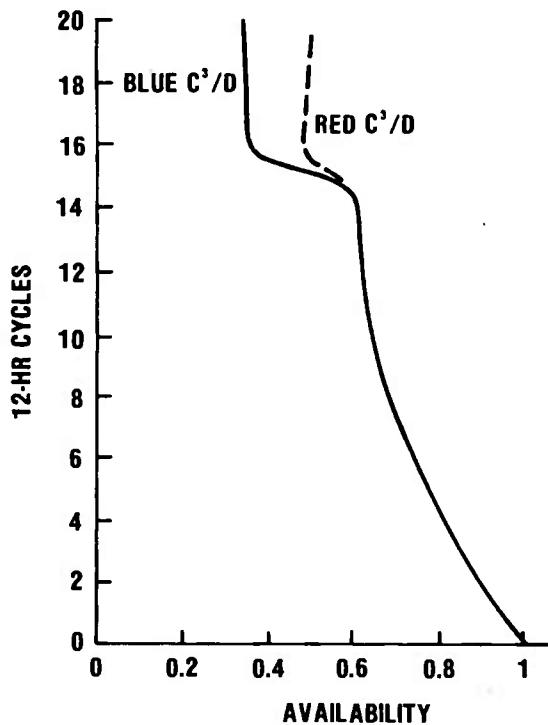


Figure 15. Reduced nuclear delivery system availability for theater echelon due to C^3/D .

6.3 Nuclear Warfare--Influence of C^3/D on Nuclear Escalation

This series of sample runs involved opposing forces engaged in a combined conventional and nuclear warfare environment. In contradistinction to warfare described in section 6.2, in which nuclear escalation could occur at the beginning of each 12-hr cycle, the present section includes the nuclear escalation authorization delay process in which a desired nuclear escalation state is reached only after a delay time influenced by C^3/D .

The sample runs were made for the simulation in which both side 1 (blue) and side 2 (red) suffer C^3/D . As in section 6.2, the simulation continued out to twenty 12-hr cycles (10 days). However, in the present set of runs, each 12-hr cycle was subdivided into six 2-hr subcycles in which possible nuclear escalation could occur. This subdivision defines better the overall escalation delay process.

Figure 16 compares the FEBA movement in sector 6 for (1) C^3/D delayed nuclear escalation, (2) 12-hr nuclear escalation, and (3) nonnuclear combat. It is seen in figure 16 that the C^3/D delayed escalation process greatly constrains nuclear combat compared with the 12-hr escalation and causes the C^3/D delayed FEBA movement to lie in a region approximately halfway between the 12-hr escalation and nonnuclear combat.

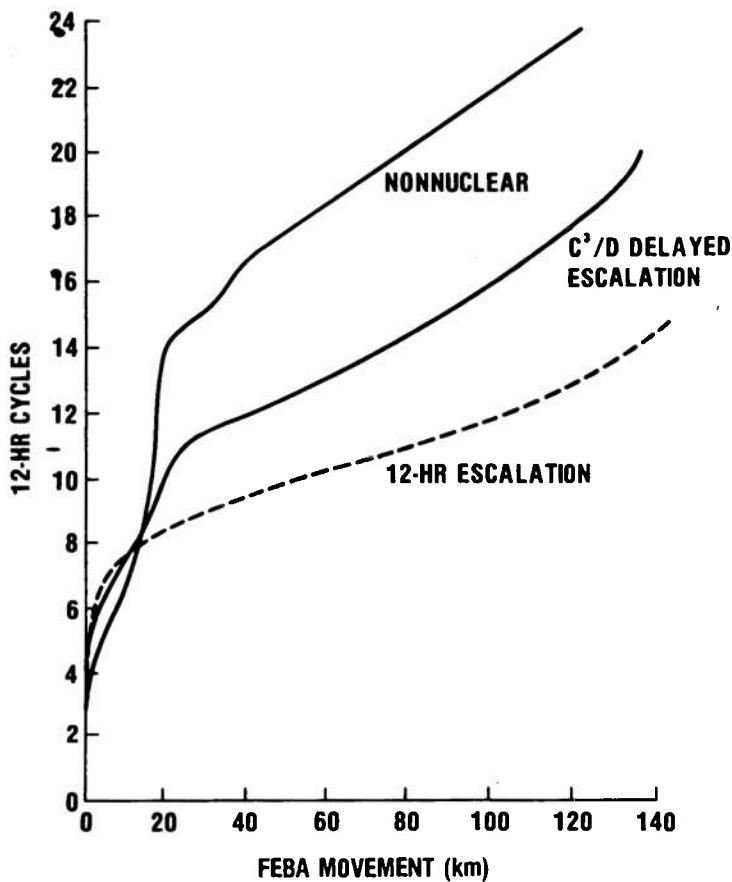


Figure 16. Forward edge of battle area movement for different nuclear escalation processes.

6.4 Target Acquisition--Influence of C³/D on Target Acquisition Processing Delay Time

A series of sample runs was made to validate the code changes in the TACWAR model used to increase the TA processing delay time due to C³/D. However, the augmentation of the TA processing delay does not manifest itself in any overall change in combat results since the TA delay time quantity is not presently used in the other TACWAR routines.

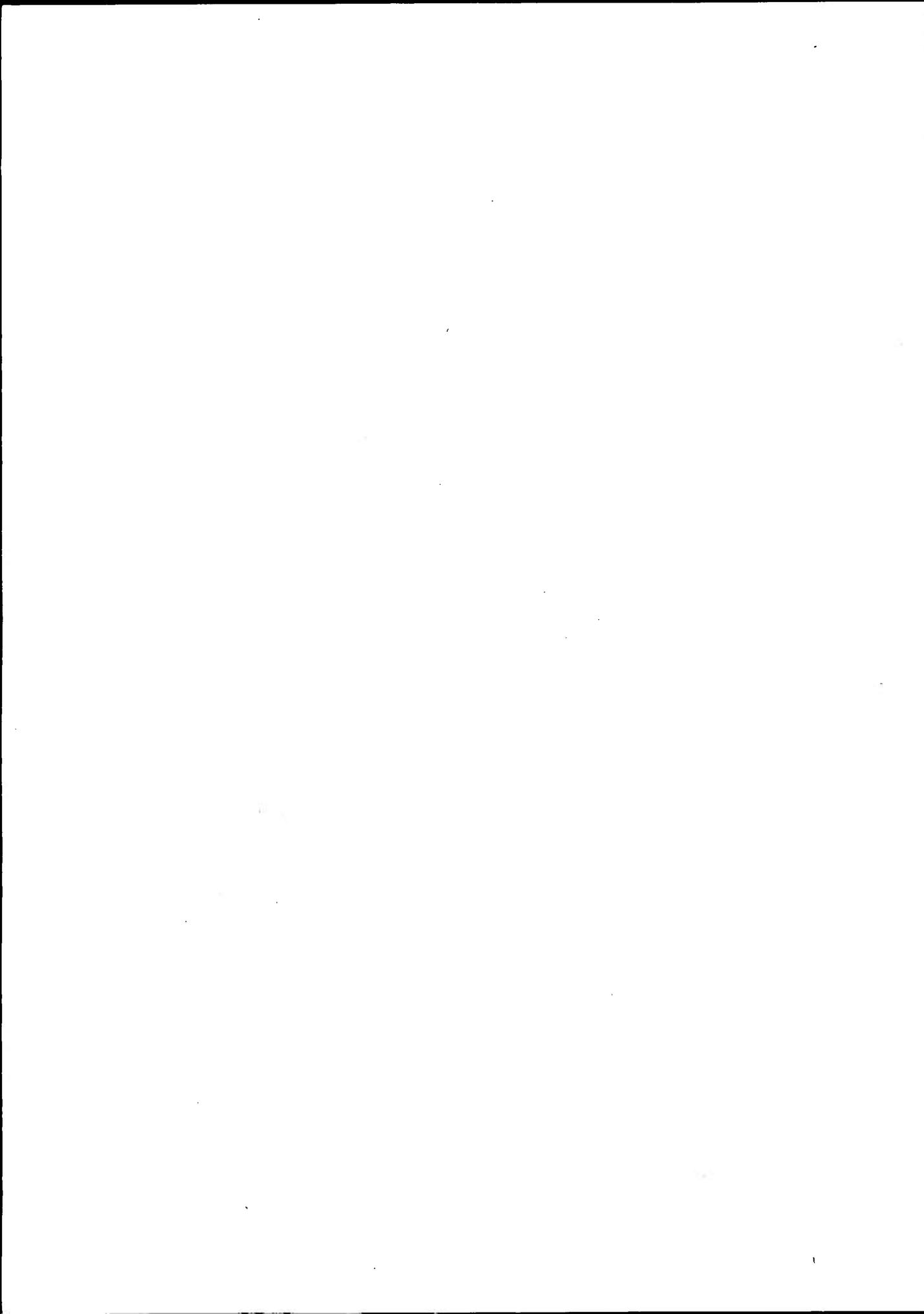
7. SUMMARY AND CONCLUSIONS

The TACWAR theater-level combat simulation model has been augmented to include command, control, and communications degradation effects in four important areas of the combat simulation:

- Division effectiveness
- Nuclear delivery system availability
- Nuclear escalation authorization delay
- Target acquisition processing delay

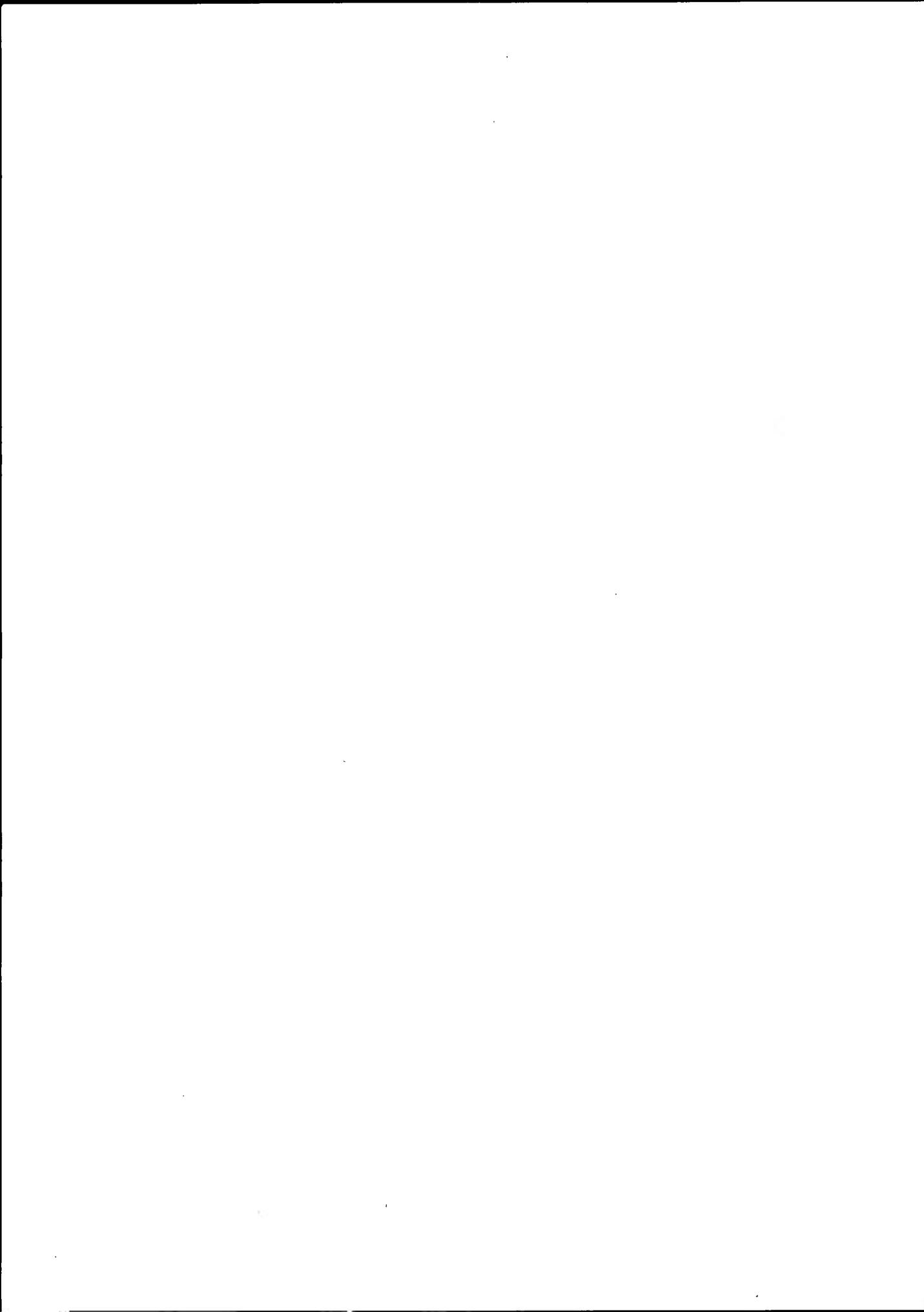
Sample runs made using a benchmark data base show noticeable changes in overall combat results (such as personnel casualties and FEBA movement) when these C³/D augmentations are included in the simulation (except the TA processing delay as mentioned in sect. 6.4).

APPENDIX A.--COMPUTER CODE CHANGES TO IMPLEMENT TACWAR AUGMENTATIONS FOR
COMMAND, CONTROL, AND COMMUNICATIONS DEGRADATION



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This appendix contains the actual computer code changes that are used to implement the TACWAR augmentations for command, control, and communications degradation (C³/D). Lines of new computer code that have been inserted into the original versions of TACWAR are indicated by the mnemonic I JCI001 in the sequence field (columns 73 to 80) of the instruction line. Similarly, lines of computer code that have been modified in the original version of TACWAR are indicated by the mnemonic C JCI001 in the sequence field. For brevity, the long common block that holds the dynamic parameters of the original version of TACWAR is indicated in any computer listing as COMMON/BBB/ enclosed between two lines of asterisks.

The appendix has five sections corresponding to the four major areas of augmentation and an ancillary or general area of augmentation:

- A-1. Division Effectiveness
- A-2. Nuclear Delivery System Availability
- A-3. Nuclear Escalation Delay
- A-4. Target Acquisition Processing Delay
- A-5. Input and Main Control

A-1. DIVISION EFFECTIVENESS

This section partially lists those subroutines that calculate division effectiveness factors, namely, FEBAMT, GC, TC, and TIMET.

```

SUBROUTINE FEBAMT
C * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
C   FEBAMT COMPUTES FEBA MOVEMENT AS A FUNCTION OF FORCE RATIO,
C   POSTURE, TERRAIN, AND MOBILITY.
C   CALLED BY GROUND
C   CALLS CVFH
C * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
      REAL NSUTD,NTSUDT,INTDA,INTDE,INTOS
***** COMMON/BCB/
***** COMMON/TNFSC3/NC3DD(2),XC3DD(8,2),YC3DD(8,2),
      *      NCMD(2),XCMD(8,2),YCMD(8,2),          I JCI001
      *      FCLWL(10,2)                           I JCI001
***** COMMON/GCFM/  INDRAW(8,2)                  I JCI001
      DIMENSION VDDSF(140),VYDDC(140)
      DIMENSION SUMM(10),ISUMM(8),ITNDSE(8)
      MOT=JCON

```

APPENDIX A

```

C -----
C 5) COMPUTE EFFECTIVENESS OF ALL DIVISIONS.
C -----
C      IF (IPRD.NE.1) GO TO 15
C      WRITE(MDT,18) ICYCLE
C      18 FORMAT('0', '***OUTPUT FROM SUBROUTINE FEBAMT. CYCLE = ',13I)
C      15 CONTINUE
C      SKIP THIS SECTION IF SECURITY FORCE RATIO IS NOT TO BE USED
C      IF (IUSFRC.EQ.0) GO TO 599
C      WVDDC = ACTUAL DIVISION WEAPON VALUE ON DEFENSE
C      PPS = DIVISION FRACTIONAL PERSONNEL STRENGTH
C      DSH = DAYS SUPPLY ON HAND
C      N2=0
C      LIM=ND(1)+ND(2)+MAD(1)+MAD(2)
C      DO 500 ID=1,LIM
C      WVDDC(ID)=0.
C      EFFDD(ID)=0.
C      VDDSF(ID)=0.
C 500  CONTINUE
C      DD 550 L=1,2
C      NI=I+N2
C      N2=N2+ND(L)
C      N3=NW(L)
C      DO 520 ID=NI,N2
C      IT=ITD(ID)
C      WVDDC(ID)=0.
C      COMD=0.
C      DO 505 IW=1,N3
C      WVDDC(ID)=WVDDC(ID)+VWOSF(IW,L)*WDIV(IW, ID)
C      TOEW=TDW(IW,IT)
C      IF (TOEW.GT.0.1) COMD=FCLWL(IW,L)*WDIV(IW, ID)/TOEW
C 505  CONTINUE
C      PPS=POIV(ID)/TPO(IT)
C      COMPUTE PERSONNEL EFFECTIVENESS
C      CALL CVFW(NDEF(L),XDEF(1,L),YDEF(1,L),PPS,PEO)
C      DSH=SDIV(ID)/PCSD(IT)
C      COMPUTE SUPPLY EFFECTIVENESS FACTOR
C      CALL CVFW(NSEFF(L),XSEFF(1,L),YSEFF(1,L),DSH,SEF)
C..... COMPUTE C*3 DEGRADATION
C      CALL CVFW(NCMD(L),XC3DD(1,L),YC3DD(1,L),CCCD,EFFC3)
C..... COMPUTE C*3/D EFFECTIVENESS FACTOR
C      CALL CVFW(NC3DD(L),XC3DD(1,L),YC3DD(1,L),CCCD,EFFC3)
C      COMPUTE DIVISION EFFECTIVENESS AND COMBAT VALUE ON DEFENSE
C      EFFDD(ID)=EFFC3*SEF*AMIN((WVDDC(ID)/WVDDTS(IT),PEO)
C      IF (IDMU.ED.3.OR.IDMU.EQ.5) GO TO 6908
C      EFFDD(ID)=EFFDD(ID)*WVDDTS(IT)
C 6908  CONTINUE
C      VDDSF(ID)=EFFDD(ID)*WVDDTS(IT)
C 520  CONTINUE
C      N2=N2+MAD(L)
C 550  CONTINUE
C      IF (IPRD.NE.1) GO TO 599
C      WRITE(MDT,117)
C      N3=ND(1)+ND(2)+MAD(1)
C      DO 580 ID=1,N3
C      IT=ITD(ID)
C      WRITE(MDT,12) ID,WVDDC(ID),WVDDTS(IT),EFFDD(ID),VDDSF(ID)
C 580  CONTINUE
C 599  CONTINUE
C -----

```

```

SUBROUTINE GC
C * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
C   GC COMPUTES ATTRITION TO PEOPLE AND WEAPONS CAUSED BY GROUND FIRE
C   AND CAS AND ALSO COMPUTES WEAPONS REPAIRABLE AND SUPPLY LOSSES.
C   CALLED BY GROUND
C   CALLS EIGENV,CVFW,MPROD,CNTRYC
C * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
REAL NSUDT,NTSUDT,INTOA,INTDE,INTDS

```

APPENDIX A

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***** COMMON/BBB/ *****
COMMON/TNFSR/NC3DD(2),XC300(8,2),YC3DD(8,2).
*           NCOMD(2),XCOMO(8,2),YCOMO(8,2).           I JC100
*           FCLWL(10,2)                                I JC100
COMMON/GCFM/  IWRAW(8,2)
DIMENSION EDAXSR(200),EDDXSR(200),VOAC(200),VDDC(200)
DIMENSION WSL10(2),AAAI(10,10,2),AAAO(10,10,2),
1  PWAKW(10,10,2),PMDKW(10,10,2),AAMA(6,10,2),
A  AAMD(6,10,2),PAAKW(7,10,2),PACKW(7,10,2),
2  BSUM(100),RSUM(100),VIWACF(10,2),VIWOCF(10,2),
3  VIAACF(10,2),VIACDF(10,2),WVOAT(10),TYPCAF(8),TYPCOF(8),
4  VLS(2),WV00T(10),WV0AC(200),WV0DC(200),PCS(2),SUMM(10),
5  TSC(2),PLS(8,2),WLS(10,2),GKGS(10,10,2),
6  AKGS(7,10,2),IHOLD(2)
DIMENSION TSL(8,2),TWS(2)
DIMENSION WLDA(10,8,2),CDACS(8,2)
MOT=JCON

C -----
C 4) ADJUST THE STANDARD ALLOCATION.
C -----
C THIS SECTION EXECUTED ONLY ON FIRST CYCLE OF GAME
IF(1CYCLE.NE.1) GO TO 499
DO 450 L=1,2
N3=NW(L)
K=3-L
N4=NW(K)
N5=NAM(L)
DO 430 KW=1,N4
IF(PWSF(KW,K).EQ.0.0) GO TO 435
DO 405 IW=1,N3
SAWA(IW,KW,L)=SAWA(IW,KW,L)/PWSF(KW,K)
SAWD(IW,KW,L)=SAWD(IW,KW,L)/PWSF(KW,K)
405 CONTINUE
DO 410 IAM=1,N5
SAMA((AM,KW,L)=SAMA((AM,KW,L)/PWSF(KW,K)
SAMD((AM,KW,L)=SAMD((AM,KW,L)/PWSF(KW,K)
410 CONTINUE
GO TO 430
415 DO 420 IW=1,N3
SAWA(IW,KW,L)=0.0
SAWD(IW,KW,L)=0.0
420 CONTINUE
DO 425 IAM=1,N5
SAMA((AM,KW,L)=0.0
SAMD((AM,KW,L)=0.0
425 CONTINUE
430 CONTINUE
450 CONTINUE
C
DO 2503 IW=1,N3
WVOAT(IT)=WVOAT(IT)+V(WACF(IW,L)*TWD(IW,IT)
WV0DT(IT)=WV0DT(IT)+VIWOCF(IW,L)*TWD(IW,IT)
2503 CONTINUE
2504 CONTINUE
DO 2525 IOS=N1,N2
ID=(DLABA(IOS,IS)
IT=ITD(IOS)
IT=ITD(IOS)
WV0AC((0)=0.
WV0DC(10)=0.
COMO=0.
DO 2505 IW=1,N3
WV0AC((D)=WV0AC((D)+V(WACF(IW,L)*WDIV(IW,1D)
WV0DC(10)=WV0DC(10)+VIWOCF(IW,L)*WDIV(IW,1D)
TOEW=TWD(IW,IT)
IF(TOEW.GT.0.0)COMO=COMO+FCLWL(IW,L)*WDIV(IW,1D)/TOEW
2505 CONTINUE
C CALCULATE EFFECTIVENESS OF PERSONNEL.
PPS=POIV(ID)/TPO(IT)

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APPENDIX A

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CALL CVFW(NEAEF(L),XAEF(1,L),YAEF(1,L,PPS,PEA)
CALL CVFWINEDEF(L),XDEF(1,L),YDEF(1,L),PPS,PEO)
EDAXSR(ID)=AMIN1((WVDAC(ID)/WVDT(1T)),PEA)
EDDXSR(ID)=AMIN1((WVDDC(ID)/WVDT(1T)),PED)
C   CALCULATE EFFECTIVENESS REDUCTION DUE TO SUPPLY SHORTAGE.
DSH=SDIV(ID)/PCSDIT)
CALL CVFW(NSEFF(L),XSEFF(1,L),YSEFF(1,L),DSH,SEF)
C.... COMPUTE C**3 DEGRADATION                                     I JC1001
CALL CVFW(NCOMD(L),XCOMD(1,L),YCOMD(1,L),COMD,CCCD)          I JC1001
C.... COMPUTE C**3/D EFFECTIVENESS FACTOR                         I JC1001
CALL CVFW(NC3DDIL),XC3DD(1,L),YC3DD(1,L),CCCD,EFFC3)          I JC1001
C   CALCULATE DIVISION EFFECTIVENESS AND GROUND VALUES
EFFDA(ID)=EFFC3*SEF*EDAXSR(ID)                                C JC1001
EFFDD(ID)=EFFC3*SEF*EDDXSR(ID)                                C JC1001
IF(10MU.EQ.3.OR.10MU.EQ.5) GO TO 6908
EFFDA(ID)=EFFDA(ID)*FDEFCP(ID)
EFFDD(ID)=EFFDD(ID)*FDEFCP(ID)
6908 CONTINUE
VDAC(ID)=EFFDA(ID)*WVDT(1T)
VDDC(ID)=EFFDD(ID)*WVDT(1T)
VGABA(1S,L)=VGABA(1S,L)*VDAC(ID)
VGDBA(1S,L)=VGDBA(1S,L)*VDDC(ID)
C
IF(IPRD.NE.1) GO TO 2525
WRITE(MOT,110)
WRITE(MOT,111) ID,IT
WRITE(MOT,111)
WRITE(MOT,221) WVDAC(ID),WVDDC(ID),WVDT(1T),WVDT(1T),EDAXSR(ID),
X   EDDXSR(ID),EFFDA(ID),EFFDD(ID),VDAC(ID),VDDC(ID)
WRITE(MOT,112)
WRITE(MOT,221) PEA,PED,DSH,SEF
2525 CONTINUE
2530 CONTINUE
IF(IPRD.NE.1) GO TO 3000
WRITE(MOT,113)
WRITE(MOT,221) (VGABA(1S,L),VGDBA(1S,L)),L=1,2
C -----
C 30) CALCULATE AIR VALUES ON ATTACK AND DEFENSE
C -----
3000 DO 3020 L=1,2
  VAABA(1S,L)=0.

```

```

SUBROUTINE TC
C * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
C   SUBROUTINE TC IS THE MAJOR THEATER CONTROL PROGRAM AND HANDLES
C   A MAJOR PORTION OF THE BOOKKEEPING EFFORT REQUIRED BY TACWAR.
C   CALLED BY THMAIN. CALLS AIRASG, APORTR, CNTRYC, CVFW, IIBA, MSREAD,
C   MSHRIT, NXDIV, SECNTH, TAG
C   ALSO CALLS 2ND HALF OF ORIGINAL RDTUINE (TCXX)
C * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
REAL NSUTD,NTSUTD,INTDA,INTDDE,INTD5
***** COMMON/BRIV/
***** COMMON/TNFSC3/NC3DD(2),XC3DD(8,2),YC3DD(8,2),          I JC1001
*   NCMD(2),XCOMD(8,2),YCOMD(8,2),          I JC1001
*   FCLWLIID,2)          I JC1001
COMMON/TCQ/SDDIV(140),SDSN(95),SDA8FS(8),SDABRS(8),
*   ITESC18,6),ITEML(8,3,2),
*   IWORK1(30),IWORK2(30),IWRK1(30,2),RWNA(10,1,2),
*   RPNABA(1,2),VDDSF(140),SUMM(10),WNDA(10,140),
*   PNDABA(140),IDDABA(140),
*   STOR1(3,8,2),STOR2(3,8,2),
*   IABAST18,
*   DISTBP(8),FRACDS(8),P2LONG(8),
*   WVDDC(140),WVDAC(140),IRDABA(2),TNNDIV(10),
*   SUNDIV17),SUA(7)
DIMENSION ASIDE(2)

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APPENDIX A

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C -----
C 451 COMPUTE EFFECTIVENESS OF ALL DIVISIONS.
C -----
C      N2=D
C      FOR EACH SIDE L DIVISION
C      DD 455D L=1,2
C      N1=1+N2
C      N2=N2+ND(L)
C      N3=NW(L)
C      DD 4520 ID=N1,N2
C      II=ITD(ID)
C      WVDAC(ID)=0.
C      WVDDC(ID)=0.
C      COMD=D.
C      COMPUTE WEAPONS VALUE ON ATTACK AND ON DEFENSE.           I JC1001
C      DD 45D5 IW=1,N3
C      WVDAC(I)D=+WVDAC(ID)+VIWASF(IW,L)*WDIV(IW, ID)
C      WVDDC(ID)=WVDDC(ID)+VIWDSF(IW,L)*WDIV(IW, ID)
C      TOEW=TWD(IW, IT)
C      IF(TCEW.GT.0.)COMD=COMD+FCLWL(IW, LI)*WDIV(IW, ID)/TOEW      I JC1001
C      I JC1001
4505 CONTINUE
C      USE PERCENT PERSONNEL STRENGTH (PPS) TO DETERMINE PERCENT
C      COMBAT EFFECTIVENESS ON ATTACK AND ON DEFENSE.
C      PPS=PDIV(ID)/TPD(IT)
C      CALL CVFW(NAEF(L), XAEF(L), YAEF(I, L), PPS, PEA)
C      CALL CVFW(NEDEF(L), XDEF(L), YDEF(I, L), PPS, PED)
C      USE DAYS OF SUPPLIES ON HAND TO DETERMINE SUPPLY EFFECT. FACTOR.
C      DSH=SDIV(ID)/PCSD(IT)
C      CALL CVFW(NSEFF(L), XSEFF(L), YSEFF(I, L), DSH, SEF)
C..... COMPUTE C*3 DEGRADATION           I JC1001
C      CALL CVFW(NCOMD(L), XCOMD(L), YCOMD(I, L), COMD, CCCD)      I JC1001
C..... COMPUTE C*3/D EFFECTIVENESS FACTOR           I JC1001
C      CALL CVFW(NC3DD(L), XC3DD(I, L), YC3DD(L), CCCD, EFC3)      I JC1001
C      COMPUTE EFFECTIVENESS OF DIVISION IN ATTACK AND ON DEFENSE.
C      EFFDA(ID)=EFC3*SEF*AMIN1(WVDAC(ID)/WVDDTS(IT)),PEA)      C JC1001
C      EFFDD(ID)=EFC3*SEF*AMIN1(WVDDC(ID)/WVDDTS(IT)),PED)      C JC1001
C      IF(IOMU.EQ.3.OR.IDOMU.EQ.5) GO TO 6908
C      EFFDA(ID)=EFFDA(ID)*FDEFCP(ID)
C      EFFDD(ID)=EFFDD(ID)*FDEFCP(ID)
6908 CONTINUE

C -----
C 901 COMPUTE EFFECTIVENESS OF DIVISIONS AND ORDER DIVISIONS IN FIRST
C INACTIVE BATTLE AREA ACCORDINGLY.
C -----
C      N2=D
C      DD 905D L=1,2
C      N1=1+N2
C      N2=N2+ND(L)
C      N3=NW(L)
C..... DETERMINE EFFECTIVENESS OF DIVISION ON ATTACK AND DEFENSE.
C      DD 902D ID=N1,N2
C      IT=ITD(ID)
C      WVDAC(ID)=D.
C      WVDDC(ID)=D.
C      COMD=D.           I JC1001
C      COMPUTE WEAPONS VALUE ON ATTACK AND ON DEFENSE.           I JC1001
C      DD 9005 IW=1,N3
C      WVDAC(I)D=+WVDAC(I)D+VIWASF(IW,L)*WDIV(IW, ID)
C      WVDDC(ID)=WVDDC(ID)+VIWDSF(IW,L)*WDIV(IW, ID)
C      TOEW=TWD(IW, IT)
C      IF(TCEW.GT.0.)COMD=COMD+FCLWL(IW, LI)*WDIV(IW, ID)/TOEW      I JC1001
C      I JC1001
9005 CONTINUE
C      USE PERCENT PERSONNEL STRENGTH (PPS) TO DETERMINE PERCENT
C      COMBAT EFFECTIVENESS ON ATTACK AND ON DEFENSE.
C      PPS=PDIV(ID)/TPD(IT)
C      CALL CVFW(NAEF(L), XAEF(L), YAEF(I, L), PPS, PEA)
C      CALL CVFW(NEDEF(L), XDEF(L), YDEF(I, L), PPS, PED)
C      USE DAYS OF SUPPLIES ON HAND TO DETERMINE SUPPLY EFFECT. FACTOR.
C      DSH=SDIV(ID)/PCSD(IT)
C      CALL CVFW(NSEFF(L), XSEFF(I, L), YSEFF(I, L), DSH, SEF)

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APPENDIX A

A-2. NUCLEAR DELIVERY SYSTEM AVAILABILITY

This section completely lists subroutine DSDEG, which determines the several delivery system degradation factors; subroutine NUCCCD, which determines the C³/D factors of airbase assets; and function NWHINV, in which the delivery system degradation factors are used. Also included is that portion of subroutine DAMEVL that is modified to include adjustment to actual airbase operating capabilities.

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SUBROUTINE DSDEG
C
C DSDEG DETERMINES THE FRACTIONAL DECREASE IN DIVISION, SECTOR, AND I JC1001
C THEATRE WEAPONS SYSTEMS BASED OF DECREASES IN DIVISION, SECTOR I JC1001
C AND THEATER ASSETS SUCH AS WEAPONS SYSTEMS, SAM SYSTEMS, SSM I JC1001
C SYSTEMS, AND AIRBASES. I JC1001
C
C REAL NSUTD,NTSUDT,INTDA,INTDE,INTDS I JC1001
***** COMMON/DB8 / *****
COMMON/TNFSC1/INABF(8,2),INABR(8,2),INABZ(2) I JC1001
COMMON/TNFSC2/NC3SD(2),XC3SD(8,2),YC3SD(8,2), I JC1001
* FDDSDA(8,2),FSDSDA(8,2),FTOSAD(8,2), I JC1001
* FABDCC(2),ABSFCC(8,2),ABSRCC(8,2),ABCZCC(2), I JC1001
* FSSMCC(2),TSSMIR(8,2),SSSMIM(8,2),SSSMIL(8,2), I JC1001
* FSAMCC(2),TSAMIR(3,2),TSAMIT(2),SSAMIF(3,2) I JC1001
COMMON/TNFSC3/NC3DD(2),XC3DD(8,2),YC3DD(8,2), I JC1001
* NCOMD(2),XCOMD(8,2),YCOMD(8,2), I JC1001
* FCLXL(10,2) I JC1001
COMMON/TNFSC4/NEDLY(2),XEDLY(8,2),YEDLY(8,2), I JC1001
* JESC(8,3,2),IWAUT(8,2),IFPLS(8,2), I JC1001
* TEQPD(2),SEQPD(8,2),CTIME(8,2) I JC1001
REAL*8 ASTYP(3) I JC1001
DIMENSION ASIDE(2) I JC1001
DATA ASTYP,ASIDE/'DIVISION','SECTOR ','THEATRE ','BLUE','RED '/ I JC1001
HOT=JCON I JC1001
00 2 L=1,2 I JC1001
TEQPD(L)=0. I JC1001
2 CONTINUE I JC1001
00 5 IS=I,NS I JC1001
NRR=D I JC1001
NDZ=0 I JC1001
00 10 L=1,2 I JC1001
NWS=NW(L) I JC1001
NRT=NR(L) I JC1001
00 15 IR=1,NRT I JC1001
IRT=IR+NRR I JC1001
IF (IS.LE.NHSR(IRT))GOTO 16 I JC1001
15 CONTINUE I JC1001
WRITE(6,900D) I JC1001
9000 FORMAT('I','NONRECOVERABLE DATA ERROR — SECTOR/REGION I JC1001
*           'INCOMPATIBILITY IN SUBROUTINE DSDEG') I JC1001
STOP I JC1001
16 CONTINUE I JC1001
F1=FABDCC(L) I JC1001
F2=FSSMCC(L) I JC1001
F3=FSAMCC(L) I JC1001
SUM=F2+F3 I JC1001

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APPENDIX A

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IF(INABR{IS,L}.GT.0.ANO.)NABZ{L].GT.0)GOTO 17           I JC1001
IF(INABR{IS,L}.GT.0 .OR. INABZ{L].GT.0)GOTO 19           I JC1001
F1=0.
F2=F2/SUM
F3=F3/SUM
GOTO 17
19 F1=F1+F1
17 ETD=0.5*F1*(ABSRCC{IS,L)+ABCZCC{L]) +F2*SSMSRS{IS,L]/TSSM]R{IS,L)+ I JC1001
* 0.5*F3*(ALRSR{1,IR,L]/TSAMIR)IR,L)+ALRSZ{1,L]/TSAMZ{L)) I JC1001
* TEQPD{L)=TEQPO{L)+ETD                                I JC1001

F1=FABDCC{L)                                         I JC1001
F2=FSSMCC{L)                                         I JC1001
F3=FSAMCC{L)                                         I JC1001
SUM=F2+F3                                         I JC1001
IF(INABF{IS,LI.GT.0)GOTO 21                         I JC1001
F1=0.                                         I JC1001
F2=F2/SUM                                         I JC1001
F3=F3/SUM                                         I JC1001
21 ESD= F1*ABSFCC{IS,L] + F3*BMRS{1,IR,L]/SSAMIF{IR,L] + I JC1001
* 0.5*F2*(SSMSFS{1,IS,L]/SSSMIM{IS,L)+SSMSFS{2,IS,L]/SSSMIL{IS,L)) I JC1001
SEQPD{IS,LI=ESD                                         I JC1001
EDD=0.                                         I JC1001
IF(NDS{IS,L).LE.0)GOTO 18                         I JC1001
ND1=1+ND2                                         I JC1001
ND2=ND2+NDS{IS,L)                                         I JC1001
DO 20 1DS=ND1,ND2                                         I JC1001
ID=IDLABA{1DS,ISI                                         I JC1001
IT=ITD{ID)                                         I JC1001
DO 22 IW=1,NWS                                         I JC1001
TOEW=TWD{IW,IT)                                         I JC1001
IF(TOEW.GT.0.)EDD=EDD+FCLWL{IW,L)*XDIV{IW,JO)/TOEW I JC1001
22 CONTINUE                                         I JC1001
20 CONTINUE                                         I JC1001
EDD=EDD/NDS{IS,L)                                         I JC1001
18 CONTINUE                                         I JC1001
EDD=SQRT{EDD+ESD)                                         I JC1001
CALL CVFWINC3S0{L),XC3S0{1,L),YC3SD{1,L),EOD,SDEG} I JC1001
FDDSA{IS,L)=SDEG                                         I JC1001
CALL CVFWINC3SD{L),XC3SD{1,L),YC3SD{1,L),ESD,SDEG} I JC1001
FSDSA{IS,L)=SDEG                                         I JC1001
CALL CVFWINC3SD{L),XC3SD{1,L),YC3S0{1,L),ETD,SOEG) I JC1001
FTDSAD{IS,L)=SDEG                                         I JC1001
NRR=NNR+NR{L)                                         I JC1001
10 CONTINUE                                         I JC1001
5 CONTINUE                                         I JC1001
DO 3 L=1,2                                         I JC1001
TEQPO{L)=TEQPD{L)/NS                                I JC1001
3 CONTINUE                                         I JC1001
IF(IPRS.NE.1)GOTO 50                                 I JC1001
WRITE{MOT,1001)ICYCLE,INCYL                           I JC1001
DO 40 L=1,2                                         I JC1001
WRITE{MOT,101)ASIDE{L),{IS,IS=1,NS)                 I JC1001
WRITE{MOT,102)ASTYP{1),{FDDSA{IS,L),IS=1,NS)       I JC1001
WRITE{MOT,102)ASTYP{2),{FSDSA{IS,L),IS=1,NS)       I JC1001
WRITE{MOT,102)ASTYP{3),{FTDSAD{IS,L),IS=1,NS)       I JC1001
WRITE{MOT,103)
40 CONTINUE                                         I JC1001
50 RETURN                                         I JC1001
100 FORMAT('1','TABLE N2A CYCLE',2X,I4,1BX,'DELIVERY SYSTEM ', I JC1001
* 'DEGRADATION FACTORS DUE TO CCC DEGRADATION'/10X,'SUBCYCLE', I JC1001
* 2X,I4/IX,II9I1H-1)
101 FORMAT('0',A4,' SIDE',5X,'SECTOR',6X,B12,0X)/512H -1) I JC1001
102 FORMAT('0',A8,' SYSTEM',8X,B4F7.3,3X)           I JC1001
103 FORMAT('///')
END                                         I JC1001

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APPENDIX A

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SUBROUTINE NUCCCO                                I JC1001
C *****NUCCCO DETERMINES THE C-3/0 FACTORS FOR AIRBASE ASSETS AT THE I JC1001
C   END OF EACH NUCLEAR / CHEMICAL SUBCYCLE      I JC1001
C *****REAL NSUTO,NTSUOT,INTOA,INTOE,INTOS      I JC1001
C *****COMMON/BB88/
C *****COMMON/TNFSC1/INABF18,21,INABR18,21,INABZ{2}          I JC1001
C *****COMMON/TNFSC2/NC350{21,XC350{8,2},YC35D18,2},          I JC1001
*      F00SA018,2),FSOSAO{B,2},FTOSAO{B,2},          I JC1001
*      FA8DCC{12},ABSFC{18,21,ABSRCC{18,21,A8CZCC{2},          I JC1001
*      FSSMCC{12},TSSMIR{18,21,SSSMI{18,21,SSSMIL{8,2},          I JC1001
*      FSAMCC{12},TSAMIR{3,21,TSAMIZ{21,SSAMIF{3,2}          I JC1001
C *****COMMON/TNFSC3/NC30D{21,XC300{8,21,YC300{8,21,          I JC1001
*      NCOMD{21,XCOMO{8,21,YCOMO{B,2},          I JC1001
*      FCLWL{10,2}          I JC1001
REAL*8 ATYP{3})                                I JC1001
DIMENSION NNABF{8,21,NNABR18,21,NNABZ121,IOPTH{71,ISIO{7} I JC1001
DIMENSION ASIOE12)                                I JC1001
DATA ATYP/'FORWARD ',' REAR ',' COMMZ '/          I JC1001
DATA ASIOE/'BLUE ',' REO '/                      I JC1001
DATA NNABF,NNABR,NNABZ/34*0/                      I JC1001
DATA IOPTH /3,2,1,4,1,2,3/                        I JC1001
DATA ISIO /2,2,2,0,1,1,1/                          I JC1001
HOT=JCON                                         I JC1001
DO 2 L=1,2                                         I JC1001
NNABZ{L}=0                                         I JC1001
ABCZCC{L}=0.                                         I JC1001
DO 3 IS=1,NS                                         I JC1001
NNABFIIS,L=0                                         I JC1001
NNABR{IS,L}=0                                         I JC1001
ABSFC{IS,L}=0.                                         I JC1001
ABSRCCIIS,L)=0.                                         I JC1001
3 CONTINUE                                         I JC1001
CONTINUE                                         I JC1001
CALL TAGINBA,NS,IABAS,NOFAB,NORAB,ISTAT)          I JC1001
DO 9 I=1,NA8                                         I JC1001
IWORO{13,II=100                                         I JC1001
IWORO{14,II=100                                         I JC1001
LOC=IAFBAIL)                                         I JC1001
IS=MOD{LOC-1,NS)+1                                I JC1001
IST=ISTATILOC1                                         I JC1001
L=ISIO1IST1                                         I JC1001
M=IOPTH{IST}                                         I JC1001
GO TU 16,7,8,9),M                                  I JC1001
C DEGSRF,R,C = DEGRADED OPERATING CAPABILITY PER NOTIONAL BASE I JC1001
C (FORWARD,REAR OR COMMZ) = SUM OF OP. CAP. OF ACTUAL BASES IN I JC1001
C SECTOR DIVIDED BY NO. ACTUAL BASES                I JC1001
6 ABSFC{IS,L)=ABSFC{IS,L)*DCNUC{1}                I JC1001
NNABFIIS,L)=NNABFIIS,L)+1                          I JC1001
GOTO9                                         I JC1001
7 ABSRCC{IS,L)=ABSRCC{IS,L)*DCNUC{1}                I JC1001
NNABR{IS,L)=NNABR{IS,L)+1                          I JI1001
GOTO9                                         I JC1001
8 ABCZCC{L)=ABCZCC{L)+DCNUC{1}                I JC1001
NNABZ{L)=NNABZ{L)+1                            I JC1001
9 CONTINUE                                         I JC1001
DO 5 L=1,2                                         I JC1001
DO 4 IS=1,NS                                         I JC1001
IFIICYCLE.GT.1 I GOTO 10                           I JC1001
INABF{IS,L)=NNABF{IS,L)                           I JC1001
INABR{IS,L)=NNABR{IS,L)                           I JC1001
INABZ{L)=NNABZ{L)                                I JC1001
10 CONTINUE                                         I JC1001
IF(INABFIIS,L).LT.0.1ABSFC{IS,L)=0.          I JC1001
IF(INABR{IS,L).LE.0.1ABSRCC{IS,L)=0.          I JC1001
IF(NNABF{IS,L).GT.0.1ABSFC{IS,L)=ABSFCC{IS,L}/NNABF{IS,L) I JC1001
IF(NNABR{IS,L).GT.0.1ABSRCC{IS,L)=ABSRCC{IS,L)/NNABR{IS,L) I JC1001
4 CONTINUE                                         I JC1001

```

APPENDIX A

```

      IF(INABZ(L).LE.0)ABCZCC(L)=0.
      IF(INNA8Z(L).GT.0)ABCZCC(L)=ABCZCC(L)/INNA8Z(L)
      5 CONTINUE
      IF(IPRS.NE.1)GOTO 2D
      WRITE(MOT,100)ICYCLE,INCYL
      00 40 L=1,2
      WRITE(MOT,101)ASIOE(L),IS,IS=1,NSI
      WRITE(MOT,102)ATYP{1},INNA8F{IS,L},ABSFCC{IS,L1},IS=1,NSI
      WRITE(MOT,102)ATYP{2},INNA8R{IS,L},ABSRCC{IS,L1},IS=1,NSI
      WRITE(MOT,102)ATYP{3},NNABZ(L),ABCZCC(L)
      40 CONTINUE
      20 CONTINUE
      RETURN
100  FORMAT('1','TABLE Q1 CYCLE',2X,I4,18X,'AIRBASE DEGRADATION ',I
      * 'FACTORS'/10X,'SUBCYCLE',2X,I4/1X,119(IH-I)
101  FORMAT('0',A4,' S10E',5X,'SECTOR',7X,B12,10X)/5(2H -I,13X,
      * B'#/2X,'DEGRADED ')I
102  FORMAT('0',AB,'AIRBASES',6X,B12,2X,F5.3,3X)I
      ENO

```

```

C RETURN
C
C SECTOR WEAPON SYSTEMS
C
200 NWHINV=NSWHS(IWS,IYO,LIS)*FSSPOS(IWS,IPOS,L)
  IF(IFLAG.EQ.2) RETURN
C
  NNWFR = NSWSI(IWS,IS,L)*FSSPOS(IWS,IPOS,L)*MNFRS(IWS,L)* C JC1001
* FSOSAO(IS,L) - NSFRS(IWS,IPOS,L) C JC1001
  IF(NNWFR .LT. NWHINV) NWHINV = NNWFR
C
  RETURN
C
C THEATER WEAPON SYSTEMS
C
300 NWHINV=NTWHT(IWS,IYD,L)*FTSPOS(IWS,IPOS,L)
  IF(IFLAG.EQ.2) RETURN
C
  NNWFR = NTWSI(IWS,IS,L)*FTSPOS(IWS,IPOS,L)*MNFRT(IWS,L)* C JC1001
* FTOSAO(IS,L) - NSFRT(IWS,IPOS,L) C JC1001
  IF(NNWFR .LT. NWHINV) NWHINV = NNWFR
C
  RETURN
C
  END

```

Subroutine DAMEVL

```

00 775 IAT = 1,7
C
C.....GET NUMBER OF SHELTERED AND UNSHELTERED A/C OF TYPE IAT IN
C     PARKING AREA IPR IN ORDER TO CALCULATE ACTUAL AIRCRAFT AND
C     SHELTER KILLS.
C
  RSH=0.
  NSUM=0
  00 750 IATT=1,7
750  IF(IPSHLA(IATT,L).LT.IPSHLA(IAT,L)) NSUM=NSUM+NACTPA(IATT,IPR)
  IF(INSUM.GT.NSHPA(IPR)) GO TO 755
  RSH =MIND(NSHPA(IPR)-NSUM,NACTPA(IAT,IPR))
755  RNUSH = FLOAT(NACTPA(IAT,IPR))- RSH
  APOM(IAT) = APDM(IAT) + RNUSH*DAMM(JPA)
  APOM(IAT)=APOM(IAT)*RSH*DAMS(JPA)
  APOMM(IAT) = APOMM(IAT) + RNUSH*(OAMM(JPA) - OAMA(JPA))
  APONT(IAT)=APOMT(IAT)+RNUSH*OAMA(JPA)+RSH*DAMS(JPA)
775  CONTINUE
C     SHELTERS DESTROYED
  SHDM = SHDM + DAMS(JPA)*FLOAT(NSHPA(IPR))
  SHDT = SHDT + DAMS(JPA)*FLOAT(NSHPA(IPR))
780  CONTINUE
790  CONTINUE
  ARHLF = 2000000.
  OLKLC = ARC/ARHLF
  IF(OLKLC .GT. 1.) OLKLC = 1. C CJC1001
C     THIS IS NECESSARY SINCE LETHAL AREA MAY COVER MORE THAN AIRFIELD
  OLKLC = OLKLC*ARHLF*POENSS/1000000. I JC1001
  CCTEM = CCTEM + ARC*POENSS/1000000. I JC1001
  CFTEM = CFTEM + ARL*POENSS/1000000. I JC1001
C
C.....PRINT A SUMMARY OF DAMAGE INFlicted.
C
  IF(IPRS .NE. 1) GO TO 6016
  WRITE(IND,6015) IAB,DLKLL,DLKLC,(APDM(IACT),IACT=1,7),SHOM,
* TMPLW
6016  CONTINUE
C
C.....UPDATE NUMBERS OF A/C SHELTERS AND PEOPLE ON AIRBASES
C

```

APPENDIX A

A-3. NUCLEAR ESCALATION DELAY

This section completely lists subroutine EDELAY, in which the delay in the preferred nuclear escalation state is determined, and subroutine NUC1, which calls EDELAY.

APPENDIX A

```

IN0=JC001
IF(IPRS.NE.0)IWRITE(IN0,90001ICYCLE,INCYL,6IS,IS=1,NS)      I JC1001
00 1C00 L=1,2                                              I JC1001
00 1200 IS=1,NS                                              I JC1001
OELAY=0.                                              I JC1001
CDEG=SQRT(TEQPO(L)*SEQPO(IS,L))                                I JC1001
COMMO(IS)=CDEG                                              I JC1001
00 1205 ITC=1,3                                              I JC1001
IF(IJESC(IS,ITC,L).LT.0.OR.JESC(IS,ITC,L).GE.)JESC(IS,ITC,L)  I JC1001
* GOTO 1205                                              I JC1001
ITMP=JESC(IS,ITC,L)                                              I JC1001
IF(IJESC(IS,ITC,L).NE.0)ITMP=-ITMP                                I JC1001
JESC(IS,ITC,L)=ITMP                                              I JC1001
1205 JESC(IS,ITC,L)=0                                              I JC1001
IF(IWAUT(IS,L).NE.0)IGOTO 1215                                I JC1001
00 1210 ITC=1,3                                              I JC1001
IF(IJESC(IS,ITC,L).NE.0)GOTO 1220                                I JC1001
1210 CONTINUE                                              I JC1001
CTIME(IS,L)=0.                                              I JC1001
DTIME(IS)=0.                                              I JC1001
GOTO 1200                                              I JC1001
1220 IWAUT(IS,L)=1                                              I JC1001
CTIME(IS,L)=0.                                              I JC1001
1225 IF(IFPLS(IS,L).NE.0)GOTO 1225                                I JC1001
CALL CVFW(NEDLY(L),XEDLY(I,L),YEOLY(1,1,L),COEG,OELAY)      I JC1001
GOTO 1230                                              I JC1001
1225 CALL CVFW(NEDLY(L),XEDLY(I,L),YEOLY(1,2,L),COEG,OELAY)      I JC1001
1230 CTIME(IS,L)=CT(ME(IS,L)+12./NNSC)                            I JC1001
DTIML(IS)=DILAY                                              I JC1001
IF(DELAY.GT.CTIME(IS,L))GOTO 1200                                I JC1001
00 1235 ITC=1,3                                              I JC1001
JESC(IS,ITC,L)=JABS(JESC(IS,ITC,L))                                I JC1001
1235 JESC(IS,ITC,L)=0                                              I JC1001
IWAUT(IS,L)=0                                              I JC1001
IFPLS(IS,L)=1                                              I JC1001
1200 CONTINUE                                              I JC1001
IF(IPRS.10.0)GOTO 1000                                              I JC1001
WRITL(1)H,9005IASIDE(L)                                              I JC1001
00 1020 IS=1,NS                                              I JC1001
AOUT(IS)=ADONE                                              I JC1001
IF(IWAUT(IS,L).EQ.0)GOTO 1015                                I JC1001
AOUT(IS)=AOELAY                                              I JC1001
GOTO 1020                                              I JC1001
1015 00 1016 ITC=1,3                                              I JC1001
IF(IJESC(IS,ITC,L).NE.0)GOTO 1018                                I JC1001
1016 CONTINUE                                              I JC1001
GOTO 1020                                              I JC1001
1018 AOUT(IS)=APRES                                              I JC1001
1020 CONTINUE                                              I JC1001
WRITE(IN0,9001)(AOUT(IS),IS=1,NS)                                I JC1001
WRITE(IN0,9002)(CTIMF(IS,L),IS=1,NS)                                I JC1001
WRITE(IN0,9003)(DTIME(IS),IS=1,NS)                                I JC1001
WRITE(IN0,9004)(COMMO(IS),IS=1,NS)                                I JC1001
1000 CONTINUE                                              I JC1001
9000 FORMAT(///1X,'TABLE NAA CYCLE ',14,5X,'DELAYED ESCALATION'/10X,I JC1001
* 'SUBCYCLE ',14/1X,119(1H-)//7X,'SECTOR',5X,8(1I,9X)/I      I JC1001
9001 FORMAT(1X,'ESCL STATUS '10(AB,2X))                                I JC1001
9002 FORMAT(1X,'CURRENT TIME '10(F8.1,2X))                                I JC1001
9003 FORMAT(1X,'OELAY TIME '10(F8.1,2X))                                I JC1001
9004 FORMAT(1X,'COMMO DEGRAO '10(F8.4,2X))                                I JC1001
9005 FORMAT('0',A4,' SIDE'/5(2H -))                                I JC1001
RETURN
C
ENO

```

APPENDIX A

```
SUBROUTINE NUC1
C
C
C      SECONDARY CALLING PROGRAM FOR THE ROUTINES WHICH
C      DETERMINE NUCLEAR ESCALATION STATES, DETERMINE
C      THE NUMBER OF NUCLEAR WEAPON SYSTEMS, AND REALLOCATES
C      STOCKS OF NUCLEAR WARHEADS TO SUPPLY POOLS.
C      SUBROUTINE NUC1 IS CALLED BY NUC AND CALLS THE
C      FOLLOWING ROUTINES  ESCLAT,  NDSYIN  AND WHINUP.
C
C
C      REAL NSUDT,NTSDUT,INTDA,INTDE,INTDS
C
C      COMMON/BBB/
C
C      COMMON/LOCAL1/AIWC(3),ASIDE(2),NIWAS,NNIWAS(2),NPT(7,4,30),
C      X      ,IWLDIS(100,2),IWLCOT(100,2),IWLTZN(100,2)
C      1      ,IWLTLD(100,2),IWLBTR(100,2),IWLT(100,2),WLYLD(100,2)
C      X      ,XIWY(42,2),KIXYF(42,2),KIXYL(42,2),NNYDS(2)
C      2      ,WLCEP(100,2),IWLBOT(100,2)
C      COMMON/LOCAA1/NSFRD(4,2,2),NSFRS(5,2,2),
C      1      ,NSFRT(5,2,2),NDT
C      COMMON/AFSTF2/ AFDIM(22,4)
C
C      IS=KISS
C
C      -----
C      DETERMINE ESCALATION STATE
C      -----
C
C      CALL ESCLAT
C      DETERMINE IF THIS CALL WAS ONLY FOR ESCALATION STATES
C      IF(KFLAG.EQ.2) GO TO 100
C
C      -----
C      DETERMINE NUMBER OF NUCLEAR DELIVERY SYSTEMS
C      -----
C
C      CALL EDELAY
C
C      DO 10 IS=1,NS
C      DO 10 ITC=1,3
C      DO 10 L=1,2
C      IF(IESC(1,IS,ITC,L).NE.0) GO TO 50
C      10 CONTINUE
C      GO TO 100
C      50 CONTINUE
C      CALL NDSYIN
C
C      -----
C      REALLOCATE INVENTORY OF NUCLEAR WARHEADS
C      -----
C
C      CALL WHINUP
C
C      100 CONTINUE
C      RETURN
C      END
```

A-4. TARGET ACQUISITION PROCESSING DELAY

This section partially lists subroutines TARACA and TADPAR, in which the target acquisition parameters for active and reserve division targets are determined.

```

SUBROUTINE TARACA
C
C***** TARACA SIMULATES ACQUISITION OF TARGETS IN THE ACTIVE BATTLE AREA
C OF A GIVEN SECTOR BY GROUND, ARMY-AIR AND AIR FORCE SENSORS
C SENSORS MAY OPERATE IN STANDOFF (FIXED OR VERTICAL), STANDOFF
C (MOVING) OR PENETRATING MODE
C SENSORS MAY BE CONTINUOUSLY OPERATING OR GLIMPSE SENSORS
C     CALLED BY TARACQ
C     CALLS TARACE
C***** REAL NSUTO,NTSUOT,INTOA,INTDE,INTOS
C***** COMMON/B88/
C***** COMMON/TNFSC1/INA8F(8,21),INA8R(8,21),INA8Z(21)           I JC1001
C***** COMMON/TNFSC2/NC3SD(21),XC3SD(8,21),YC3SD(8,21)           I JC1001
C     .     FDDSDA(8,21),FSDSDA(8,21),FTDSAD(8,21)           I JC1001
C     .     FABDCC(21),ABSFCC(8,21),ABSRCC(8,21),ABCZCC(21)   I JC1001
C     .     FSSMCC(21),TSSMIR(8,21),SSSMIR(8,21),SSSMIL(8,21) I JC1001
C     .     FSAMCC(21),TSAMIR(3,21),TSAMIZ(21),SSAMIF(3,21)  I JC1001
C***** COMMON/TNFSC3/NC3DD(21),XC3DD(8,21),YC300(8,21)         I JC1001
C     .     NC0MD(21),XCOMD(8,21),YCOMO(8,21)           I JC1001
C     .     FCLWL(10,21)           I JC1001
C***** COMMON/TNFSC4/NEDLY(2),XEDLY(8,21),YEDLY(8,2,21)        I JC1001
C     .     JESC(8,3,21),IWAUT(8,21),IFPLS(8,21)           I JC1001
C     .     TEOPD(21),SEOP0(8,21),CTIME(8,2)           I JC1001
C***** COMMON/TNFSC5/NGSFD(21),XGSFO(8,21),YGSFD(8,21)        I JC1001
C     .     NAAFD(21),XAAFD(8,21),YAAFD(8,21)           I JC1001
C     .     NAFFD(21),XAFFD(8,21),YAFFD(8,21)           I JC1001
C***** COMMON/LDCAL3/ JS
C
C     THESE ARE WORKING VARIABLES TARGET ACQUISITION NEEDS ONLY.
C     COMMON /TACQ/ V1STHZ(40,111),CE1THZ(40,111),RVLOST(6),
C     .     INZBA(112), KTERTA(112)
C * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
C     DIMENSION PGSDT(7,4,301),PDS20S(7,4,301),GAP(21),AS10E(21)
C     LOGICAL*1 LJCI(41),HJCI(4)
C     EQUIVALENCE(LJCI(1),TJCT),(HJCI(1),IJCI)
C     DATA ASIDE/'BLUE','RED' /           I JC1001
C
C100)  INITIALIZE WORKING VARIABLES
C
C     IJCI=0
C     FNNSC=1.
C     N2=0
C     DO 6 L=1,2
C     N1=1+N2
C     N2=N2+NDSC(J5,L)
C     N3=NSU(L)
C     N4=N2(L)
C     IF(IUTAM.EQ.1) GO TO 6
C     .... TARGET ACQUISITION MODEL NOT USED, DETECTION PROB., SENSOR ERROR
C     .... AND DELAY TIME ARE USER INPUT
C     DU 3 IOS=N1,N2
C     DO 3 ISU=1,N3
C     DO 3 IZ=1,N4
C     PSZDDS(ISU,IZ,IDS)=PSZD(ISU,IZ,L)

```

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N5=NZ(111
N6=NW(11
IJ=NDS(JS,111
IJJ = NDS(JS,L1
C
C.... GIVEN A SENSING AND A TARGET DIVISION, COMPUTE DETECTION PROB FOR
C EACH SENSOR TYPE(IGS) VS EACH SUBUNIT TYPE(1S1) IN EACH ZONE(IZ1
21 IL1=IDLABA(1CTSD,JS1
IFIL.EQ.21 IL1=IDLABA(1CTSD+IJ,JS1
IT1=ITD(IL1)
COMD=0.
DO 211 IW=1,N6
TOEW=TWD(IW,IT1)
IF(TGEW.GT.0.COMD=COMD+FCLWL(IW,L1)*WDIV(IW,IL1)/TOEW
211 CONTINUE
CALL CVFW(NCOMD(IL1),XCOMD11,L1),YCOMD(1,L1),COMD,CCCD1
CALL CVFH(NGSFD(IL1),XGSFD11,L1),YGSFD(1,L1),CCCD,COMD1
C.... TSX = LOCATION OF SENSOR GROUP
TSX=TSX+ITFAC*DWDTH(IT11)/2.
IJ = NDS(JS,11 + ICTTD
IF(L1.EQ.21 IJ = ICTTD
IL2 = IDLABA(1CTTD,JS1
ITEMP = ICTTD + IJJ
IF(IJ.EQ.21 IL2 = IDLABA(ITEMP,JS1
IT2=ITD(IL2
C.... DSX = HORIZONTAL DISTANCE, SENSORS TO TARGET EDGE

C.... PASDT = PROBIPARTIC SENSOR ACQUIRES PARTIC TARGET - GLIMPSE)
PASDT=1.-(1.-PDGE)*(GLPGS11IGS,L1*TAC1
C.... TEMP2 IS PROBABILITY OF NON-DETECTION BY ANY
24 TEMP2=(1-PASDT)*TEMP1
IF(ITEMP2.LT.1.E-10)TEMP2=0.
C.... SENSOR OF THIS TYPE
C.... TEMP2 = PROB(1NO TYPE IGS SENSORS ACQUIRE A PARTICULAR TARGET)
C.... TEMP3 = PROB(AT LEAST 1 TYPE IGS SENSOR ACQUIRES A PARTIC TARGET)
TEMP3=1.-TEMP2
C.... PDSZDS WILL BE USED TO COMPUTE OVERALL SENSOR ERROR AND DELAY TIME
PDSZDS11ISU,1Z,111=PDSZDS11ISU,1Z,111*TEMP3
C.... FIND RUNNING VALUE OF PROBABILITY OF NON DETECTION
C.... PGSDT = PROB(1NO SENSOR OF ANY TYPE ACQUIRES A PARTICULAR TARGET)
TJCI=PGSDT11ISU,1Z,111
IF(TJCI.EQ.0.1GOTO 24D1
TJCI=TJCI+TEMP2
IF(TJCI.LT.1.E-10)TJCI=0.
PGSDT11ISU,1Z,111=TJCI
24D1 CONTINUE
DO 27 IRBST=1,NN
IF(RANGE.LE.VHRBST11RBST,L1) GO TO 28
27 CONTINUE
IRBST=NN
C.....TAESZD11ISU,1Z,111 = TAESZD11ISU,1Z,111 + (TEMP3*TACGSRLIGS,
* IRBST,L1)**2
TAESZD11ISU,1Z,111=TAESZD11ISU,1Z,111+TEMP3*(TAOTGS11IGS,L1*COMD)
IF(IIPRD.EQ.0) GO TO 25
WRITE1JNUC,32D1 DINTEG,RANGE
WRITE1JNUC,33D1 IGS,IL1,ISU,1Z,IL2
WRITE1JNUC,20D1 PASDT,TEMP3
25 CONTINUE
DY=DY*(PZDPTH(1Z,111*DVDPTH(1T2)/2.)
26 CONTINUE
30 CONTINUE
IF(IPR0.EQ.0) GO TO 31

```

```

C-----  

C400) TARGET ACQUISITION BY AIR FORCE SENSORS  

C-----  

C-----  

C.... COMPUTE DETECTION PROB FOR EACH SENSOR TYPE(IAFS) ON EACH TYPE  

C      ARMY-AIR CARRIER(IAC) ON EACH MISSION(IM=1 STANDOFF, =2 PENETRA-  

C      TING) VS EACH TYPE SUBUNIT(SU) IN EACH ZONE(IZ) OF EACH TARGET  

C      DIVISION(IDS)  

C      N7=NAAC(L)  

C      N3=NAS(L)  

C      N6=NDS(JS,11)  

C      CEIT = CEITWZ(1TT,1WZ)  

C      VIST=VISTWZ(1TT,1WZ)/1000.  

C      CCCD=SEQPD(JS,L)  

C      CALL CVFW(NAAFD(L),XAAFD(1,L),YAAFD(1,L),CCCD,COMO)           I JC1001  

C      I JC1001  

C-----  

C.... ITERATE FOR EACH DIVISION  

DO 80 IDS=1,N6  

JDS=IDS  

IF(1).EQ.2) JDS=JDS+NDS(JS,L)  

IL2=IDLABA(JDS,JS)  

IT2=ITD(IL2)  

C-----  

C.... ITERATE FOR EACH TYPE OF ARMY AIRCRAFT  

DO 77 IAAC=1,N7  

C.... PC = PROB(CEILING > SENSOR ALTITUDE)  

PC=0.  

IF(AMOAAC(IAAC,L).LE.CEIT) PC=1.  

C.... DSX = HORIZONTAL DISTANCE, SENSORS TO TARGET EDGE  

DSX=FDWLAC(IAAC,L)*DVWDTH(IT2)  

C-----  

C.... ITERATE OVER MODEL TYPE. IM=1 IS STANDOFF MOVING  

C      IM=2 IS FORWARD AREA. 2M=3 IS DEEP AREA WHICH DOES NOT  

C      APPLY TO DIVISIONS IN THE ACTIVE BATTLE AREA.  

DO 76 IM=1,2  

C.... ASCP = NO. OPERATIONAL ARMY-AIR CARRIERS ON MISSION IM  

ASCP=(AACS(IAAC,JS,L)+ACDS(IAAC,JS,L))*1-FRAAC(IAAC,L))+  

PAACAM(IAAC,IM,L)  

C.... ASCD IS NUMBER OF AAC AVAILABLE ASSUME 1 SORTIE/CYCLE  

C      ADJUST VALUES BY THE VARIABLE RAASDT  ARMY AIRCRAFT  

C      HAVE ALREADY BEEN ATTRIBUTED  

C-----  

C.... UPDATE RESULTS  

C.... PASDT = PROB(PARTIC SENSOR ACQUIRES PARTIC TARGET - GLIMPSE)  

PASDT = 1. - (1.-POGE)**(GLPAS(IAS,L)*TACL)  

C.... TEMP2 = PROB(1N TYPE IAS SENSOR ACQUIRES A PARTICULAR TARGET)  

68 TEMP2=(1.-PASDT)**TEMP1  

IF(TEMP2.LT.1.E-10)TEMP2=0.           I JC1001  

C.... TEMP3 = PROB(AT LEAST 1 IAS SENSOR ACQUIRES A PARTICULAR TARGET)  

TEMP3=1.-TEMP2  

PDSZDS(1SU,1Z,JDS)=PDSZDS(1SU,1Z,JDS)+TEMP3  

TJCI=PGSDT(1SU,1Z,JDS)  

IF(TJCI.EQ.0.)GOTO 6801  

TJCI=TJCI+TEMP2  

IF(TJCI.LT.1.E-10)TJCI=0.  

PGSDT(1SU,1Z,JDS)=TJCI  

6801 DO 71 IRBST=1,NN  

IF(RANGE.LE.VHRBST(IRBST,L)) GO TO 72  

71 CONTINUE  

IRBST=NN           I JC1001  

72 TAESZD(1SU,1Z,JDS) = TAESZD(1SU,1Z,JDS) + (TEMP3*TACASR(IAS,  

C-----  

C400) TARGET ACQUISITION BY AIR FORCE SENSORS  

C-----  

C-----  

C.... COMPUTE DETECTION PROB FOR EACH SENSOR TYPE(IAFS) ON RECON A/C ON  

C      EACH MISSION(IM) VS EACH SUBUNIT TYPE(SU) IN EACH ZONE(IZ) OF  

C      EACH TARGET DIVISION(IDS)  

NR1=1           I JC1001  

NR2=NR(1)           I JC1001

```

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1F1L.EQ.1)GOTO 809          I JC1001
NR1=NR11)+1                 I JC1001
NR2=NR11)+NR(2)             I JC1001
809  DO 810 IRR=NR1,NR2      I JC1001
IF IJS.GE.NHSRIIRR)GOTO 811  I JC1001
810  CONTINUE                I JC1001
IRR=1                        I JC1001
811  NR1=NLSRIIRR           I JC1001
NR2=NHSRIIRR                I JC1001
CCCD=0.                      I JC1001
DO B12 IRR=NR1,NR2          I JC1001
812  CCCD=CCCD+SECPD(IRR,L)  I JC1001
CCCD=CCCD/INR2-NR1+1)       I JC1001
CALL CVFHINAFFDIL,XAFFD(I,L),YAFFD(I,L),CCCD,COMD)  I JC1001
N3=NAFS(L)
C.... PC = PROB(CEILING > SENSOR ALTI
PC=0.
IF IAMORACIL).LE.CEITI PC=1.
DO 95 IDS=1,N6
JDS=IDS
IFI11.EQ.2) JDS=JDS+NDSE(JS,L)
IL2=IDLABA(JDS,JS)
IT2=ITDILIL2)
C.... DSX = HORIZONTAL DISTANCE, SENSORS TO TARGET
DSX=FDWLRAIL)DVWDTIIT2)
DU 94 IM=1,2
IF(RACAM(JS,IM,L).LT..0001) GO TO 94
C
C.... AVAILABILITY HAS BEEN ACCOUNTED FOR IN COMPUTING NUMBER OF
C      MISSION, RACAM. ATTRITION FOR PREVIOUS CYCLE IS NOT IN RACAM
C      SO AN ATTRITION TERM IS NEEDED
C.... TEMP = NO. OF RECON A/C
TEMP=RACAM(JS,IM,L)*(1.-RAAFRM6(M,L)*FRLPMA(IM,L))*SRRAC(L)/FNNSC
C
C.... PROCEED IN A MANNER EXACTLY ANALGOUIS TO THE PREVIOUS SECTION
DO 93 IAFS=1,N3
DY = D.
IF(IM .EQ. 2) DY = DRAFT(L)
C.... TEMP1 = NO. OF SENSORS PER TARGET DIVISION
C.... PASDT = PROBIPARTIC SENSOR ACQUIRES PARTIC TARGET - GLIMPSEI
PASDT=1.-(1.-PDGE)**IGLPAFSCIAFS,L)*TACL
88  TEMP2=(1.-PASDT)**TEMP1
IF(TEMP2.LT.1.E-10)TEMP2=0.
TEMP3=1.-TEMP2
PDSZDIIISU,IZ,JDS)=PDSZDS(IISU,IZ,JDS)+TEMP3
TJC1=PGSOTIISU,IZ,JDS)
IF(TJC1.EQ.0.)GOTO 8801
TJC1=TJC1+TEMP2
IF ITJJC1.LT.1.E-10)TJC1=0.
PGSUTIISU,IZ,JDS)=TJC1
8801 DO 91 IRBST=1,NN
IF(RANGE.LE.VHRBSTIIRBST,L)) GO TO 92
91  CONTINUE                I JC1001
IRBST=NN.
92  TAESZD(IISU,IZ,JDS) = TAESZD(IISU,IZ,JDS)+(TEMP3*TACAFR6IAFS,IRBST,
* L))**2
TADSZDIIISU,IZ,JDS)=TADSZD(IISU,IZ,JDS)+TEMP3*(TADTAF6IAFS,L)+COMD)

```

SUBROUTINE TADPAR

```

C
C*****SUBROUTINE TADPAR
C      TADPAR SIMULATES ACQUISITION OF TARGETS TO THE REAR OF THE ACTIVE
C      BATTLE AREA BY ARMY-AIR AND AIR FORCE SENSORS
C      CALLED BY TARACQ
C*****
```

APPENDIX A

```

REAL NSUDU, NISUDU, INTDU, INTDS
***** COMMON/888/
***** COMMON/TNFSC1/ INABF(8,2),INABR(8,2),INABZ(2)
***** COMMON/TNFSC2/ NC3SD(2),XC3SD(8,2),YC3SD(8,2),
*      FDDSD(8,2),FSOSAD(8,2),FTDSAD(8,2),          I JC1001
*      FA80CC(2),A85FCC(8,2),ABSRC(8,2),ABCZCC(2),  I JC1001
*      FSSMCC(2),TSSMIR(8,2),SSSMIM(8,2),SSSMIL(8,2), I JC1001
*      FSAMCC(2),TSAMIR(3,2),TSAMIZ(2),SSAMIF(3,2)  I JC1001
***** COMMON/TNFSC3/ NC3DD(2),XC3DD(8,2),YC3DD(8,2),
*      NC3MD(2),XC3MD(8,2),YC3MD(8,2),          I JC1001
*      FCLWL(10,2)                                I JC1001
***** COMMON/TNFSC4/ NFDLY(2),XEDLY(8,2),YEDLY(8,2),
*      JES(8,3,2),IAUT(8,2),IFPLS(8,2),          I JC1001
*      TEQPD(2),SEQPD(8,2),CTIME(8,2)           I JC1001
***** COMMON/TNFSC5/ NGSF0(2),XGSFD(8,2),YGSFD(8,2),
*      NAAFD(2),XAAFD(8,2),YAAFD(8,2),          I JC1001
*      NAFFD(2),XAFFD(8,2),YAFFD(8,2)           I JC1001
***** COMMON/LOCAL3/ JS

C THESE ARE WORKING VARIABLES TARGET ACQUISITION NEEDS ONLY.
COMMON /TACQ/ VISTWZ(40,11),CEITWZ(40,11),RVLOST(6),
1           IWZBA(112), KTERTA(112)
C TARGET ACQUISITION DEEP AREA DETECTION ROUTINE.
DIMENSION PDAASS(4,7), PDAFSS(4,7), ASIOE(2)
DATA ASIOE/'BLUE','RED'                                I JC1001
IF(IUTAM.EQ.11 GO TO 20

C-----C100) DETECTION PRUBABILITY, SENSOR ERROR AND DELAY TIME ARE USER INPUT
C-----C (TARGET ACQUISITION MODEL NOT USED)
C-----C
DO 15 L=1,2
N1=NSU(L)
J=N2(L)
DO 10 ISU=1,N1
PSRADS(ISU,L)=PSZD(ISU,L,L)
TAESEA(ISU,L)=TASESZ(L,L)
TADSRA(ISU,L)=TADTSZ(L,L)
10 CONTINUE
15 CONTINUE
RETURN
C-----C200) INITIALIZE WORKING VARIABLES
C-----C
20 FNNSC=1.
IND=JNUC                                I JC1001
IF(IPRS.NE.0)IWRITE(IND,100)ICYCLE,JS      I JC1001
DO 80 L=1,2

C-----C
IF(RACAM(JS,3,L).LT..0001) GO TO 65
C-----C RACP = NO. RECON A/C ON DEEP SEARCH
RACP=RACAM(JS,3,L)*(1.-RAAFRM(3,L)*FRLPMA(3,L)*SRRAC(L))/FNNSC
DO 60 IAFS=1,N4
TEMP1=RACP*PRAFSM(IAFS,3,L)/MDIVO
IF(TEMP1.LE..0001) GO TO 60
DO 50 ISU=1,N3
TEMP=SWATUS(IAFS,ISU,L)*VELRAC(L)*TAFSSD(IAFS,L)/OAREA
PASDT=1.-EXP(-TEMP)
TEMP2=(1.-PASDT)*TEMP1
PDAFSS(IAFS,ISU)=1.-TEMP2
PSRADS(ISU,K)=PSRADS(ISU,K)+TEMP2
50 CONTINUE
60 CONTINUE
65 CONTINUE
C-----C
SUMMARIZE AND NORMALIZE RESULTS IN SAME FASHION AS IN TARACA
C

```

APPENDIX A

```

      CCCD=SEQPD(J5,L)
      CALL CVFWENAAFD(L),XAAFD(1,L),YAAFD(1,L),CCCD,COMDAA)      I JC1001
      NR1=1
      NR2=NR(1)
      IF(L.EQ.1)GOTO 809
      NR1=NR(1)+1
      NR2=NR(1)+NR(2)
  809  DO 810 IRR=NR1,NR2
      1F(J5.GE.NHSR(IRR))GOTO 811
  810  CONTINUE
      IRR=1
  811  NR1=NHSR(IRR)
      NR2=NHSR(IRR)
      CCCD=D.
      DO 812 IRR=NR1,NR2
  812  CCCD=CCCD+SEQPD(IRR,L)
      CCCD=CCCD/(NR2-NR1+1)
      CALL CVFW(NAFFD(L),XAFFD(1,L),YAFFD(1,L),CCCD,COMDAFI
      DO 70 ISU=1,N3
      TSENSR=D.
      DO 66 IAS=1,N2
      TSENSR=TSENSR+PDAASS(IAS,ISU)
  66  CONTINUE
      DO 67 IAFS=1,N4
      TSENSK=TSENSR+PDAFSS(IAFS,ISU)
  67  CONTINUE
      DO 68 IAS=1,N2
      1F(TSENSR.EQ.0.) GO TO 68
      PDAASS(IAS,ISU)=PDAASS(IAS,ISU)/TSENSR
      TAESRA(ISU,K)=TAESRA(ISU,K)+(PDAASS(IAS,ISU)*SEADAD(IAS,L))**2.
      TADSRA(ISU,K)=TADSRA(ISU,K)+PDAASS(IAS,ISU)*(TADTAS(IAS,L)+COMDAA)
  68  CONTINUE
      DO 69 IAFS=1,N4
      1F(TSENSR.EQ.0.) GO TO 69
      PDAFSS(IAFS,ISU)=PDAFSS(IAFS,ISU)/TSENSR
      TAESRA(ISU,K)=TAESRA(ISU,K)+(PDAFSS(IAFS,ISU)*SEAFDA(IAFS,L))**2.
      TADSRA(ISU,K)=TADSRA(ISU,K)+PDAFSS(IAFS,ISU)*(TADTAF(IAFS,L)+COMDAF)
      *                                         ) JC1001
  69  CONTINUE

```

A-5. INPUT AND MAIN CONTROL

This section completely lists subroutine TMAIN, which controls the overall flow of the TACWAR combat simulation, and subroutine TNFINP, which controls the C³/D input data to TACWAR.

```

      SUBROUTINE TMAIN
C
C      * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
C      TMAIN SETS UP A CYCLE COUNTER WHICH CONTROLS INTERMITTANT MODEL
C      FUNCTIONS. TMAIN ACTIVATES AIR,NUCLEAR,CHEMICAL,TARGET ACQUISITION
C      GROUND,SUPPLIES AND THEATER CONTROL MODELS.
C      CALLED BY NMMAIN. CALLS MSREAD AND APDRTRN.
C
C      * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
C      DIMENSION ARST(5)
      DATA ARST/4H$TRE,4HNT$,4HRENT,4H$TRE,4HNT /
      COMMON /R5RTY/ NR5RT(3)
      REAL NSUTD,NTSUDT,INTDA,INTDE,INTDS
      * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
      COMMON/BBB/
      * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *

```

APPENDIX A

```

COMMON/TNFSC2/NC3SO(2),XC3SO(8,2),YC3SO(8,2),          I JC1001
*      FOOSAD(8,2),FSDSAO(8,2),FTDSA0(8,2),          I JC1001
*      FABDCC(2),ABSFCC(8,2),ABSRCC(8,2),ABCZCC(2),  I JC1001
*      FSSHCC(2),TSSMIR(8,2),SSSHM(8,2),SSSMIL(8,2), I JC1001
*      FSAMCC(2),TSAMIR(3,2),TSAMIZ(2),SSAMIF(3,2)   I JC1001
COMMON/TNFSC3/NC30D(2),XC300(8,2),YC300(8,2),          I JC1001
*      NCOND(2),XC0MO(8,2),YC0MD(8,2),                I JC1001
*      FCLWL(10,2)                                     I JC1001

C
REAL*8 NAMES(16),QNAME
INTEGER IPRJNT(16),ICHNUC(2,2),IZZ1,IZZ2,IZZ3          I JC1001
DATA NAMES/'QAPORT  ','QPSAIR  ','QPSUMY  ','QAIMO  ','QCHEM  ','Q
*      QNUC   ','QTARAQ  ','QGND   ','QAJRGO  ','QTC   ','Q
*      QSUPPLY  ','QTIMET  ','QWRRST  ','QTNFIN  ','QDSDEG  ','Q
*      QNUCCD  '/
DATA IPRINT/16*7/, ICHNUC/4*7/                      I JC1001
100 FORMAT(10X,20I3)                                  I JC1001
101 FORMAT(8,2X,3(1I,4X))                           I JC1001
C-----C
C 10) INITIALIZATION
C-----C
C
IRST=17
HOT=JCON
READ(5,100,END=25)NCYCLE,NNSC                      I JC1001
READ(5,100,END=25)IPR00                               I JC1001
READ(5,100,END=25)()PRSO(1),I=1,201                I JC1001
READ(5,100,END=25)()OHU                               I JC1001
21 READ(5,101,END=25)QNAME,IZZ1,IZZ2,IZZ3          I JC1001
DO 22 I=1,16                                         I JC1001
IF(QNAME.NE.NAMES())GOTO 22                         I JC1001
IPRJNT(I)=IZZ1                                       I JC1001
IF(QNAME.NE.NAMES(5).AND.QNAME.NE.NAMES(6))GOTO 21 I JC1001
ICHNUC(1,I-4)=IZZ2                                   I JC1001
ICHNUC(2,I-4)=IZZ3                                   I JC1001
GOTO 21                                              I JC1001
22 CONTINUE                                           I JC1001
C
JCON=IPRINT(14)                                     I JC1001
CALL TNF}NP                                         I JC1001
I JC1001

C 25 CONTINUE
C-----C

C-----C
C      ALLOCATE NOTIONAL AIRBASE TO REAL AIRBASES UNLESS THIS IS A
C      RESTART RUN.
C-----C
C
IF(NRSTRT(1).GT.1) GO TO 10                         I JC1001
JCON=IPRINT(1)
CALL 'APORTN(1)
10 CONTINUE
C-----C
C      PRINT TABLES FOR CYCLE PRECEEDING START OF GAME.
C-----C
C
ICYCLE=0
IF(NRSTRT(1).GT.1) ICYCLE=NRSTRT(3)*2-1          I JC1001
JSUM=IPRINT(2)
CALL PSAIR
JSUM=IPRJNT(3)
CALL PSUMMY
I JC1001
I JC1001

C-----C
C      SET GAME CYCLE COUNTER. INITIALIZE MAJOR SUPPLY CYCLE
C      COUNTER TO NCSM = NO. COMBAT CYCLES IN A MAJOR SUPPLY CYCLE.
C-----C

```

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```

11 IIFLAG = 0
  IF(NRSTRT(1).GT.11 GO TO 900
  GO TU 901
900 IIFLAG = 1
  ICYCLE = NRSTRT(3) + 2
  GO TO 902
901 ICYCLE = 1
902 CONTINUE
  ICSM=NCSM
  IF(NCSM.LE.01 GO TO 904
903 IF(ICSM.GE.ICYCLE) GO TO 904
  ICSM = ICSM + NCSM
  GO TO 903
904 CONTINUE
C
C-----C 201 EXECUTE AIR MODEL
C      STATEMENT 1000 IS THE STARTING POINT FOR CALCULATIONS EACH CYCLE.
C      BEGIN BY SETTING PRINT FLAG IPRD=1 (PRINT) IF CYCLE IN ARRAY IPRD0
C-----C
C      IF (NRSTRT(2).ED.1.AND.IIFLAG.ED.1) GO TO 1015
1000 DU 1010 II=1,5
  IF(ICYCLE.ED.IPRD0(1)) GO TO 1015
  IF(ICYCLE.LT.IPRD0(1)) GO TO 1020
1010 CONTINUE
  GO TU 1020
1015 IPRD=1
  GO TU 1025
1020 IPRD=0
1025 CONTINUE
  IF(ICMU.ED.7) GO TO 1021
  JCON=IPRINT(4)
  CALL AIRMOD
I JC1001

C
C-----C 30) EXECUTE NUCLEAR AND CHEMICAL MODELS
C-----C
C-----C      ARE NUCLEAR AND CHEMICAL WEAPONS CONSIDERED ?
C-----C
C      IF(ICMU.EQ.5) GO TO 700
C-----C      ALLOCATE NOTIONAL AIRBASES TO REAL AIRBASES
C-----C
C      JCON=IPRINT(1)
  CALL APORNT(1)
I JC1001
1021 CONTINUE
C
C-----C      FOR NNSC SUBCYCLES
C      SET FLAG AND CALL NUC AND CHEM FOR DETERMINING ESCALATION
C      STATE AND CHEMICAL EMPLOYMENT LEVEL
C-----C
C      NITC=3
  KNUCH=0
C
C-----C      SET IPRS FOR SUMMARY OUTPUT
C-----C
C      IPRS=0
  DO 1 II=1,30
  IF(ICYCLE.EQ.IPRSD(1)) GO TO 2
  IF(ICYCLE.LT.IPRSD(1)) GO TO 3

```

APPENDIX A

```

1 CONTINUE
GO TO 3
2 IPRS=1
3 IF(ICYCLE.EQ.1.OR.ICYCLE.EQ.NCYCLE) IPRS=1
IF (IIFLAG.EQ.1) IPRS = 1
C
C----- BEGIN CALCULATIONS FOR EACH SUBCYCLE  INCYL
C----- -
C
DO 600 INCYL=1,NNSC
C
C----- IF NO CHEM OR NUC WEAPONS USED AFTER FIRST SUBCYCLE,LEAVE DO-LOOP.
C----- -
C
CJC1 IF(INCYL.GT.1.AND.KNUCH.EQ.0) GO TO 700          C JC1001
KFLAG=1
KISS=0
C
JCON=IPRINT(16)          I JC1001
CALL NUCCCO               I JC1001
C
JCON=IPRINT(15)          I JC1001
CALL OSOEG                 I JC1001
C
C----- IF CHEM WEAPONS ARE TO BE PLAYED CHEM DETERMINES CHEMICAL
C----- EMPLOYMENT LEVEL AND INITIALIZES CHEMICAL MODEL
C----- -
C
IF (IDMU.EQ.3.OR.IDMU.EQ.5) GO TO 12          I JC1001
JCHEM=IPRINT(5)
CALL CHEM
KFLAG=1
KISS=0
C
C----- IF NUC WEAPONS ARE TO BE PLAYED NUC DETERMINES ESCALATION
C----- STATE AND INITIALIZES NUCLEAR MODEL
C----- -
C
12 IF (IDMU.EQ.4.OR.IDMU.EQ.5) GO TO 13          I JC1001
JNUC=IPRINT(6)
CALL NUC
13 KFLAG = 0
C
C----- BEGIN NUC AND CHEM CALCULATIONS FOR EACH SECTOR KISS = 15.
C----- -
C
DO 500 IS=1,NS
KISS=15
C
C----- DETERMINE IF THIS SECTOR HAS A POSITIVE ESCALATION STATE
C----- -
C
DO 310 L=1,2
DO 310 ITC=1,NITC
IF(IESC(IS,ITC,L).GT.0) GO TO 320
310 CONTINUE
C
C----- NO USE OF NUCLEAR WEAPONS IN THIS SECTOR
C----- -
C
KNUC=0
GO TO 350

```

APPENDIX A

```
C
C----- C NUCLEAR WEAPON ARE TO BE USED
C----- C KNUCH INDICATES NUCLEAR OR CHEMICAL WEAPON USE
C----- C
C 320 KNUC=1
    KNUCH=KNUCH+1
C----- C DETERMINE IF THIS SECTOR HAS A POSITIVE EMPLOYMENT LEVEL
C----- C
C 350 CONTINUE
    00 360 L=1,2
    00 360 ITC=1,NITC
    IF(ITEML(1,ITC,L).GT.0) GO TO 370
    360 CONTINUE
C----- C NO USE OF CHEMICAL WEAPONS IN THIS SECTOR
C----- C
C      KCHEM=0
    GO TO 400
C----- C CHEMICAL WEAPONS ARE TO BE USED
C----- C
C 370 KCHEM=1
    KNUCH=KNUCH+1
C----- C IF THE ESCALATION STATE OR THE EMPLOYMENT LEVEL WAS POSITIVE
    CONDUCT TARGET ACQUISITION IF NOT GO TO NEXT SECTOR
C----- C
C 400 CONTINUE
    IF(INCYL.GT.1) GO TO 405
    KIPRD=IPRD
    CJCI IPRD=0
C----- C TARACQ PERFORMS TARGET ACQUISITION CALCULATIONS
C----- C
C      JNUC=IPRINT(7)
    CALL TARACQ
    IPRD=KIPRD
    I JC1001
C----- C DETERMINE ORDER OF USE OF WEAPONS
C----- C
C 405 CONTINUE
    IF(KNUC.EQ.0. ANO. KCHEM.EQ.0) GO TO 500
    IF(IOMU.EQ.1.OR.IOMU.EQ.3.OR.IOMU.GE.6) GO TO 410
    GO TO 460
C----- C NUCLEAR WEAPONS ARE USED FIRST IF ALLOWED
C----- C
C 410 CONTINUE
    IF(KNUC.EQ.0) GO TO 420
    I JC1001
```

APPENDIX A

```
C
C----- C NUC PERFORMS NUCLEAR DAMAGE CALCULATIONS IN SECTOR KISS
C----- C
C      JNUC=ICHNUC(1,2)          I JC1001
C      CALL NUC
C
C----- C
C----- C ARE CHEMICAL WEAPONS USED IN ADDITION TO NUCLEAR WEAPONS ?
C----- C
C
420 CONTINUE
  IF(I0NUC.EQ.3) GO TO 500
  IF(KCHEM.EQ.0) GO TO 500
C
C----- C CHEM PERFORMS CHEMICAL DAMAGE CALCULATIONS IN SECTOR KISS
C----- C
C      JCHEM=ICHNUC(1,1)          I JC1001
C      CALL CHEM
C      GO TO 500
C
C----- C
C----- C CHEMICAL WEAPONS ARE USED FIRST IF ALLOWED
C----- C
C
460 CONTINUE
  IF(KCHEM.EQ.0) GO TO 470
C
C----- C ADDITIONAL CHEMICAL DAMAGE CALCULATIONS BY CHEM
C----- C
C      JCHEM=ICHNUC(1,1)          I JC1001
C      CALL CHEM
C
C----- C
C----- C ARE NUCLEAR WEAPONS USED IN ADDITION TO CHEMICAL WEAPONS ?
C----- C
C
470 CONTINUE
  IF(I0NUC.EQ.4) GO TO 500
  IF(KNUC.EQ.0) GO TO 500
C
C----- C
C----- C ADDITIONAL NUCLEAR DAMAGE CALCULATIONS BY NUC
C----- C
C      JNUC=ICHNUC(1,2)          I JC1001
C      CALL NUC
C
C----- C
C----- C END OF DO-LOOP ON SECTOR IS = KISS
C----- C
C
500 CONTINUE
C
C----- C
C----- C END OF DO-LOOP ON SUBCYCLE INCYL
C----- C
C
C      I JC1001
C
C----- C
C----- C 600 CONTINUE
C
C----- C
C----- C NUCLEAR AND CHEMICAL DAMAGE CALCS. FINISHED FOR THIS CYCLE
C----- C
```

APPENDIX A

```

C      IF(IOMU.EQ.7) GO TO 1022
C
C----- C ALLOCATE REAL AIRBASES TO NOTIONAL AIRBASES
C----- C
C      JCON=IPRINT(1)                                I JC1001
C      CALL APORTN(2)
1022 CONTINUE
    700 CONTINUE
C
C----- C 40) EXECUTE REMAINING PARTS OF TACWAR MODEL FOR THIS CYCLE
C----- C
C----- C GROUND PERFORMS GROUND COMBAT CALCULATIONS
C----- C
C      IF(IOMU.GE.6) GO TO 1041
C      JCON=IPRINT(8)                                I JC1001
C      CALL GROUND
C
C----- C AIRGRD PERFORMS AIR-GROUND CALCULATIONS
C----- C
C      JCON=IPRINT(9)                                I JC1001
C      CALL AIRGRD
1041 CONTINUE
    IF (IIFLAG.EQ.1) GO TO 1026
    IF(ICYCLE.EQ.1.OR.ICYCLE.EQ.NCYCLE) GO TO 1026
    IF(IPRD.EQ.1) GO TO 1026
    DO 1027 II=1,30
    IF(ICYCLE.EQ.IPRS0(II)) GO TO 1026
    IF(ICYCLE.LT.IPRS0(II)) GO TO 1028
1027 CONTINUE
    GO TO 1028
1026 CONTINUE
    IF(IOMU.EQ.7) GO TO 1028
C
C----- C PSAIR PRINTS AIR-GROUND SUMMARY, AS REQUIRED
C----- C
C      JSUM=IPRINT(2)                                I JC1001
C      CALL PSAIR
1028 CONTINUE
C
C----- C IF ICYCLE NOT LAST CYCLE IN GAME, SET FLAGS FOR CALLS TO NUC AND
C----- C     CHEM TO CALCULATE NUCLEAR ESCALATION STATE AND CHEM EMPLOYMT LEVEL
C----- C
C      KFLAG=2
C      KISS=0
C      INCYL=0
C
C----- C NUC DETERMINES NUCLEAR ESCALATION STATE IF NUC WEAPONS ARE PLAYED
C----- C
C      IF(IOMU.EQ.3.OR.IOMU.EQ.5) GO TO 14
C      JCHEM=ICHNUC(2,1)                                I JC1001
C      CALL CHEM
C
C----- C CHEM DETERMINES CHEMICAL EMPLOYMENT LEVEL IF CHEM WEAPONS PLAYED.
C----- C

```

APPENDIX A

```

14 IF(IOMU.EQ.4.OR.IOMU.EQ.5) GO TO 15
    JNUC=ICHNUC(2,2)
    CALL NUC
15 KFLAG = 0
    IF(IOMU.GE.6) GO TO 1090
C-
C----- TC PERFORMS THEATER CONTROL AND BOOKKEEPING CALCULATIONS
C----- 
C      JCON=IPRINT(10)                                I JC1001
C      CALL TC
C      IF(ICYCLE.NE.{CSM) GO TO 1030
C-
C----- FOR MAJOR RESUPPLY CYCLE, SUBROUTINE SUPPLY MAKES SUPPLY
C----- MODEL CALCULATIONS
C----- 
C      JCON={PRINT(11)                                I JC1001
C      CALL SUPPLY
C-
C----- INCREMENT NEXT MAJOR RESUPPLY CYCLE
C----- 
C      ICSM=ICSM+NCSM
1030 IF (ICYCLE .NE. .2*100) GO TO 16
C-
C----- TIMEIT READS INPUTS IF TIME-T VARIABLES ARE TO BE INPUT THIS CYCLE
C----- 
C      JCON=IPRINT(12)                                I JC1001
C      CALL TIMEIT
16 IF(((FLAG.EQ.1) GO TO 1040
    IF){CYCLE.EQ.1.OR.ICYCLE.EQ.NCYCLE) GO TO 1040
    IF){PRD.EQ.1) GO TO 1040
    DO 1035 II=1,30
    IF((CYCLE.EQ.)PRSO(1)) GO TO 1040
    IF((CYCLE.LT.{PRSO(1)) GO TO 1090
1035 CONTINUE
    GO TO 1090
1040 CONTINUE
C-
C----- PSUMMY PRINTS SUMMARY TABLES FOR GROUND AND THEATER
C----- CONTROL VARIABLES
C----- 
C      JSUM={PRINT)3                                I JC1001
C      CALL PSUMMY
C      IIFLAG = 0
C-
C----- CHECK TO DETERMINE IF THIS TACWAR RUN WILL CREATE
C----- RESTART FILE. IF SO, COPY BLANK COMMON FOR EACH
C----- COMBAT DAY TO THE OUTPUT RESTART FILE. (IRST = 17)
C----- 
C1090 IF)NRSTRT(1).EQ.1.OR.NRSTRT(1).EQ.3) GO TO 1050
    GO TO 1055
1050 IF (MOD(ICYCLE,21.E0.0) GO TO 1055
    NDAY = )CYCLE + 1) / 2
    WRITE ((RST,1051) ARST, NDAY
1051 FORMAT(1X,A18,(4I
    JCON=IPR(NT)13)
    CALL WRRST((RST)
1055 CONTINUE
C

```

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```

C-----C
C      END OF CALCULATIONS FOR THIS CYCLE. STOP IF LAST (NCYCLE) CYCLE;
C      OTHERWISE, INCREMENT ICYCLE AND BEGIN CALCULATIONS FOR NEW CYCLE.
C-----C
C      IF (ICYCLE.GE.NCYCLE) GO TO 1099
C      ICYCLE=ICYCLE+1
C      GO TO 1000
C
C 1099 IF(NRSTRT(1).EQ.1).OR.NRSTRT(1).EQ.3) REWIND 1RST
C      RETURN
C      ENO

SUBROUTINE TNF INP
TNF INP READS IN DATA ASSOCIATED WITH CCC DEGRADATION OF NUCLEAR
RESOURCES
REAL NSUDT,NTSUDT,INTOA,INTDE,INTDS
COMMON/BBB/
COMMON/TNF SCI/INABF(8,2),INABR(8,2),INABZ(21
COMMON/TNF SC2/NC3SD(2),XC3SD(8,2),YC3SD(8,2),
          F00SDA0(8,2),F00SDAD(8,2),FT0SDA0(8,2),
          FABDCC(2),ABSFCC(8,2),ABSRCC(8,2),ABCZCC(21,
          FSSMCC(2),TSSM1R(8,2),SSSM1M(8,2),SSSM1L(8,2),
          FSAMCC(2),TSAMIR(3,2),TSAMIZ(2),SSAMIF(3,2)
COMMON/TNF SC3/NC3DD(2),XC3DD(8,2),YC3DD(8,2),
          NC0MD(2),XC0MD(8,2),YC0MD(8,2),
          FCLWL(10,2)
COMMON/TNF SC4/HEODY(2),YEOLY(8,2),YEOLY(8,2,2),
          JESC(8,3,2),IWAUT(8,2),IFPLS(8,2),
          TEOPD(2),SEOPD(8,2),CTIHE(8,2)
COMMON/TNF SC5/NGSFD(2),XGSFD(8,2),YGSFD(8,2),
          NAAFO(2),XAAFO(8,2),YAAFO(8,2),
          NAFFD(2),XAFFD(8,2),YAFFD(8,2)
REAL*8 APARM(31)
DATA APARM/'NC300  ','XC300  ','YC300  ','NC0MO  ','XC0MO  ',',
          'YC0MO  ','FCLWL  ','NC350  ','XC350  ','YC350  ',',
          'FABOCC  ','FSSMCC  ','FSAHCC  ','TSSM1R  ','SSSM1M  ',',
          'SSSM1L  ','TSAMIR  ','TSAMIZ  ','SSAM1F  ','NEOLY  ',',
          'XEOLY  ','YEOLY  ','NGSFO  ','XGSFD  ','YGSFO  ',',
          'NAAFO  ','XAAFD  ','YAAFO  ','NAFFD  ','XAFFD  ',',
          'YAFFD  '/
DIMENSION ASIDE(2)
DATA ASIDE/'BLUE','RED '
FORMAT(10X,20I3)
FORMAT(1X,A6,I0(3X,14))
FORMAT(1DX,1D6.0)
FORMAT(1X,A6,10I3X,F8.3)
FORMAT('0 INITIAL TNFS VALUES FOR ',A4,' SIDE')
FORMAT(1X,'NORMALIZED VALUES FOR FCLWL')
NOT=JCON
00 30 L=1,2
REA0(5,1001
WRITE(M0T,1D41ASIDE(L)
READ(5,100,END=25,ERR=28)NC300(L)
WRITE(M0T,101)APARM(1),NC300(L)
NN=IHC300(L)
READ(5,102,END=25,ERR=28)(XC300(I,L),I=1,NN)
WRITE(M0T,103)APARM(2),(XC300(I,L),I=1,NN)
READ(5,102,END=25,ERR=28)(YC300(I,L),I=1,NN)
WRITE(M0T,1D31APARM(3),(YC300(I,L),I=1,NN)
READ(5,100,END=25,ERR=28)NC0MO(L)
WRITE(M0T,101)APARM(41),NC0MO(L)
NN=NC0MD(L)

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APPENDIX A

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REA015,102,ENO=25,ERR=28{(XC0MD{I,L},I=1,NN}
WRITE(M0T,103)APARM{5},{XC0MD{I,L},I=1,NN} I JC1001
REA015,102,ENO=25,ERR=28{(YC0MD{I,L},I=1,NN} I JC1001
WRITE(M0T,103)APARM{6},{YC0MD{I,L},I=1,NN} I JC1001
NN=NW(L) I JC1001
REA015,102,ENO=25,ERR=28{(FCLWL{I,L},I=1,NN} I JC1001
WRITE(M0T,103)APARM{7},{FCLWL{I,L},I=1,NN} I JC1001
REA015,100,ENO=25,ERR=28)NC3SO(L) I JC1001
WRITE(M0T,101)APARM{8},NC3SO(L) I JC1001
NN=NC3SO(L) I JC1001
REA015,102,ENO=25,ERR=28{(XC3SO{I,L},I=1,NN} I JC1001
WRITE(M0T,103)APARM{9},{XC3SO{I,L},I=1,NN} I JC1001
REA015,102,ENO=25,ERR=28{(YC3SO{I,L},I=1,NN} I JC1001
WRITE(M0T,103)APARM{10},{YC3SO{I,L},I=1,NN} I JC1001
REA015,100,ENO=25,ERR=28)NEOLY(L) I JC1001
WRITE(M0T,101)APARM{101},NEOLY(L) I JC1001
NN=NEOLY(L) I JC1001
REA015,102,ENO=25,ERR=28{(XEOLY{I,L},I=1,NN} I JC1001
WRITE(M0T,103)APARM{21},{XEOLY{I,L},I=1,NN} I JC1001
00 10 J=1,2 I JC1001
REA015,102,ENO=25,ERR=28{(YEOLY{I,J,L1},I=1,NN} I JC1001
WRITE(M0T,103)APARM{22},{YEOLY{I,J,L1},I=1,NN} I JC1001
CONTINUE I JC1001
REA015,100,ENO=25,ERR=28)NGSFO(L) I JC1001
WRITE(M0T,101)APARM{23},NGSFO(L) I JC1001
NN=NGSFO(L) I JC1001
REA015,102,ENO=25,ERR=28{(XGSFO{I,L},I=1,NN} I JC1001
WRITE(M0T,103)APARM{24},{XGSFO{I,L},I=1,NN} I JC1001
REA015,102,ENO=25,ERR=28)({YGSFO{I,L},I=1,NN} I JC1001
WRITE(M0T,103)APARM{25},{YGSFO{I,L},I=1,NN} I JC1001
REA015,100,ENO=25,ERR=28)NGSFO(L) I JC1001
WRITE(M0T,101)APARM{26},NAAFO(L) I JC1001
NN=NAAFO(L) I JC1001
REA015,102,ENO=25,ERR=28)({XAAFO{I,L1},I=1,NN} I JC1001
WRITE(M0T,103)APARM{27},{XAAFO{I,L},I=1,NN} I JC1001
REA015,102,ENO=25,ERR=28)({YAAFO{I,L},I=1,NN} I JC1001
WRITE(M0T,103)APARM{28},{YAAFO{I,L},I=1,NN} I JC1001
REA015,100,ENO=25,ERR=28)NAFFO(L) I JC1001
WRITE(M0T,101)APARM{29},NAFFO(L) I JC1001
NN=NAFFO(L) I JC1001
REA015,102,ENO=25,ERR=28)({XAFFO{I,L},I=1,NN} I JC1001
WRITE(M0T,103)APARM{30},{XAFFO{I,L},I=1,NN} I JC1001
REA015,102,ENO=25,ERR=28)({YAFFO{I,L},I=1,NN} I JC1001
WRITE(M0T,103)APARM{31},{YAFFO{I,L1},I=1,NN} I JC1001
REA015,102,ENO=25,ERR=28)FAROCC(L) I JC1001
WRITE(M0T,103)APARM{11},FABOCC(L) I JC1001
REA015,102,ENO=25,ERR=28)FSSMCC(L) I JC1001
WRITE(M0T,103)APARM{12},FSSMCC(L) I JC1001
REA015,102,ENO=25,ERR=28)FSAMCC(L) I JC1001
WRITE(M0T,103)APARM{13},FSAMCC(L) I JC1001
00 40 IS=1,NS I JC1001
IF(55MSRS{1,L}.GT.0.)TSSMIR{IS,L}=55MSRS{IS,L} I JC1001
IF(55MSFS{1,IS,L1}.GT.0.)SSSMIM{IS,L}=55MSFS{1,IS,L} I JC1001
IF(55MSFS{2,IS,L}.GT.0.)SSSMIL{IS,L}=55MSFS{2,IS,L} I JC1001
CONTINUE I JC1001
WRITE(M0T,103)APARM{14},{TSSMIR{IS,L},IS=1,NS} I JC1001
WRITE(M0T,103)APARM{15},{SSSMIM{IS,L},IS=1,NS} I JC1001
WRITE(M0T,103)APARM{16},{SSSMIL{IS,L},IS=1,NS} I JC1001
NRI=NRI(L) I JC1001
00 42 IR=1,NRT I JC1001
IF(ALRSR{1,IR,L}.GT.0.)TSAMIR{IR,L}=ALRSR{1,IR,L} I JC1001
IF(BMRS{1,IR,L}.GT.0.)SSSAMIF{IR,L}=BMRS{1,IR,L} I JC1001
CONTINUE I JC1001
IF(ALRSZ{1,L}.GT.0.)TSAMIZ{L}=ALRSZ{1,L} I JC1001
WRITE(M0T,103)APARM{17},{TSAMIR{IR,L},IR=1,NRT} I JC1001
WRITE(M0T,103)APARM{18},TSAMIZ{L} I JC1001
WRITE(M0T,103)APARM{19},{SSSAMIF{IR,L1},IR=1,NRT} I JC1001
NN=NW(L) I JC1001
SUMM=0. I JC1001
00 32 I=1,NN I JC1001
SUMM=SUMM+FCLWL{I,L1} I JC1001
IF(SUMM.LE.0.)GOTO 35 I JC1001

```

APPENDIX A

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DO 34 I=1,NN
34  FCLWL(I,L)=FCLWL(I),L)/SUMM          I JC1D01
35  WRITE(MDT,105)                          I JC1D01
      WRITE(MDT,103)APARM(71,(FCLWL(I,L),I=1,NN) I JC1D01
30  CONTINUE                                I JC1001
25  CONTINUE                                I JC1D01
      RETURN                                  I JC1D01
28  WRITE(6,999)                            I JC1001
999  FORMAT('I','*** ERROR OCCURRED IN SUBROUTINE TNFIMP ON DATA ', I JC1D01
      *          'READIN ***')                 I JC1001
      STOP                                     I JC1D01
      END                                      I JC1D01

      BLOCKDATA
      COMMUN/TNFSC2/NC3SD(2),XC3SD(8,2),YC3SD(8,2),          I JC1D01
      *          FDDSDA(8,2),FSDSDA(8,2),FTDSAO(8,2),          I JC1D01
      *          FABDCC(2),ABSFCC(8,2),ABSRCC(8,2),ABCZCC(2),  I JC1D01
      *          FSSMCC(2),TSSMIR(8,2),SSSMIM(8,2),SSSMIL(8,2), I JC1001
      *          FSAMCC(2),TSAMIR(3,2),TSAMIZ(2),SSAMIF(3,2)  I JC1D01
      COMMON/TNFSC3/NC3DD(2),XC3DD(8,2),YC3DD(8,2),          I JC1001
      *          NC0MD(2),XC0MD(8,2),YC0MD(8,2),          I JC1D01
      *          FCLWL(10,2)                                I JC1D01
      DATA NC3DD,NC0MD,NC3SD/6*0/                  I JC1D01
      DATA XC3DD,XC0MD,XC3SD/48*0./               I JC1001
      DATA YC3DD,YC0MD,YC3SD/48*0./               I JC1D01
      DATA FCLWL/20*0./                           I JC1001
      DATA FABDCC,FSSMCC,FSAMCC/6*0./             I JC1D01
      DATA TSSMIR,SSSMIM,SSSMIL/48*0.0D1/          I JC1D01
      DATA TSAMIR,TSAMIZ,SSAMIF/14*0.0D1/          I JC1D01
      DATA ABSFCC,ABSRCC,ABCZCC/34*1./            I JC1D01
      END                                         I JC1D01
      BLOCK DATA
      COMMUN/TNFSC1/INABF(8,2),INABR(8,2),INABZ(2)          I JC1001
      COMMON/TNFSC2/NC3SD(2),XC3SD(8,2),YC3SD(8,2),          I JC1D01
      *          FDDSDA(8,2),FSDSDA(8,2),FTDSAO(8,2),          I JC1D01
      *          FABDCC(2),ABSFCC(8,2),ABSRCC(8,2),ABCZCC(2),  I JC1D01
      *          FSSMCC(2),TSSMIR(8,2),SSSMIM(8,2),SSSMIL(8,2), I JC1001
      *          FSAMCC(2),TSAMIR(3,2),TSAMIZ(2),SSAMIF(3,2)  I JC1D01
      COMMON/TNFSC3/NC3DD(2),XC3DD(8,2),YC3DD(8,2),          I JC1001
      *          NC0MD(2),XC0MD(8,2),YC0MD(8,2),          I JC1D01
      *          FCLWL(10,2)                                I JC1001
      COMMON/TNFSC4/NEFLY(2),XEDLY(8,2),YEDLY(8,2,2),          I JC1001
      *          JESC(8,3,2),IWAUT(8,2),IFPLS(8,2),          I JC1D01
      *          TEQPD(2),SFQPD(8,2),CTIMER(2)              I JC1001
      COMMON/TNFSC5/NGSFD(2),XGSFD(8,2),YGSFD(8,2),          I JC1001
      *          NAAFD(2),XAAFD(8,2),YAAFD(8,2),          I JC1D01
      *          NAIFFD(2),XAIFFD(8,2),YAIFFD(8,2)          I JC1001
      DATA INADF,INABR,INABZ/34*0/                      I JC1001
      DATA NC3SD/7*0/                                    I JC1D01
      DATA XC3SD,YC3SD,FDDSDA,FSDSDA,FTDSAO/8D*0./          I JC1001
      DATA FABDCC,ABSFCC,ABSRCC,ABCZCC/36*0./            I JC1001
      DATA FSSMCC,TSSMIR,SSSMIM,SSSMIL/50*0./             I JC1001
      DATA FSAMCC,TSAMIR,TSAMIZ,SSAMIF/16*0./            I JC1D01
      DATA NC3DD,NC0MD,NEFLY,JESC,IWAUT,IFPLS/86*0/          I JC1001
      DATA XC3DD,YC3DD,XC0MD,YC0MD,XEDLY,YEDLY/112*0./          I JC1001
      DATA FCLWL,TEQPD,SEQPD,CTIME/54*0./               I JC1D01
      DATA NGSFD,NAAFD,NAFFD/6*0/                      I JC1D01
      DATA XGSFD,YGSFD,XAAFD,YAAFD,XAFFD,YAFFD/96*0./          I JC1D01
      END                                         I JC1D01

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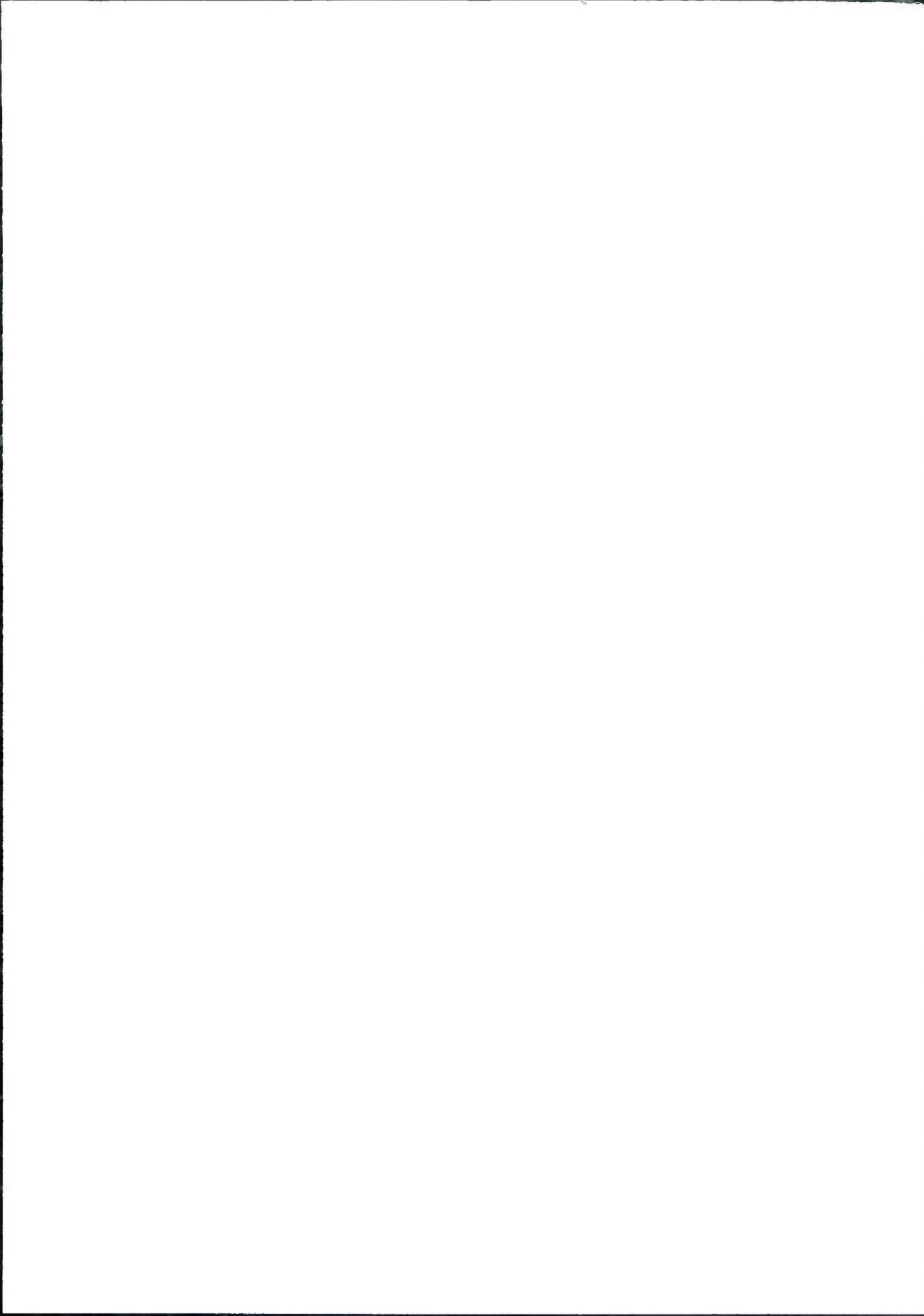
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